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T E R R A:
A
PHILOSOPHICAL DISCOURSE
OF
E A R T H.

RELATING TO THE
CULTURE and IMPROVEMENT of it for VEGETATION, and the
PROPAGATION of PLANTS, as it was presented to the
ROYAL SOCIETY.

BY
J. EVELYN, Esq; F.R.S.

WITH NOTES
By A. HUNTER, M.D. F.R.S.

Y O R K:

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M.DCC.LXXXVII.

THE
HISTORICAL
AND
GEOGRAPHICAL
DEPARTMENT

BRITISH MUSEUM



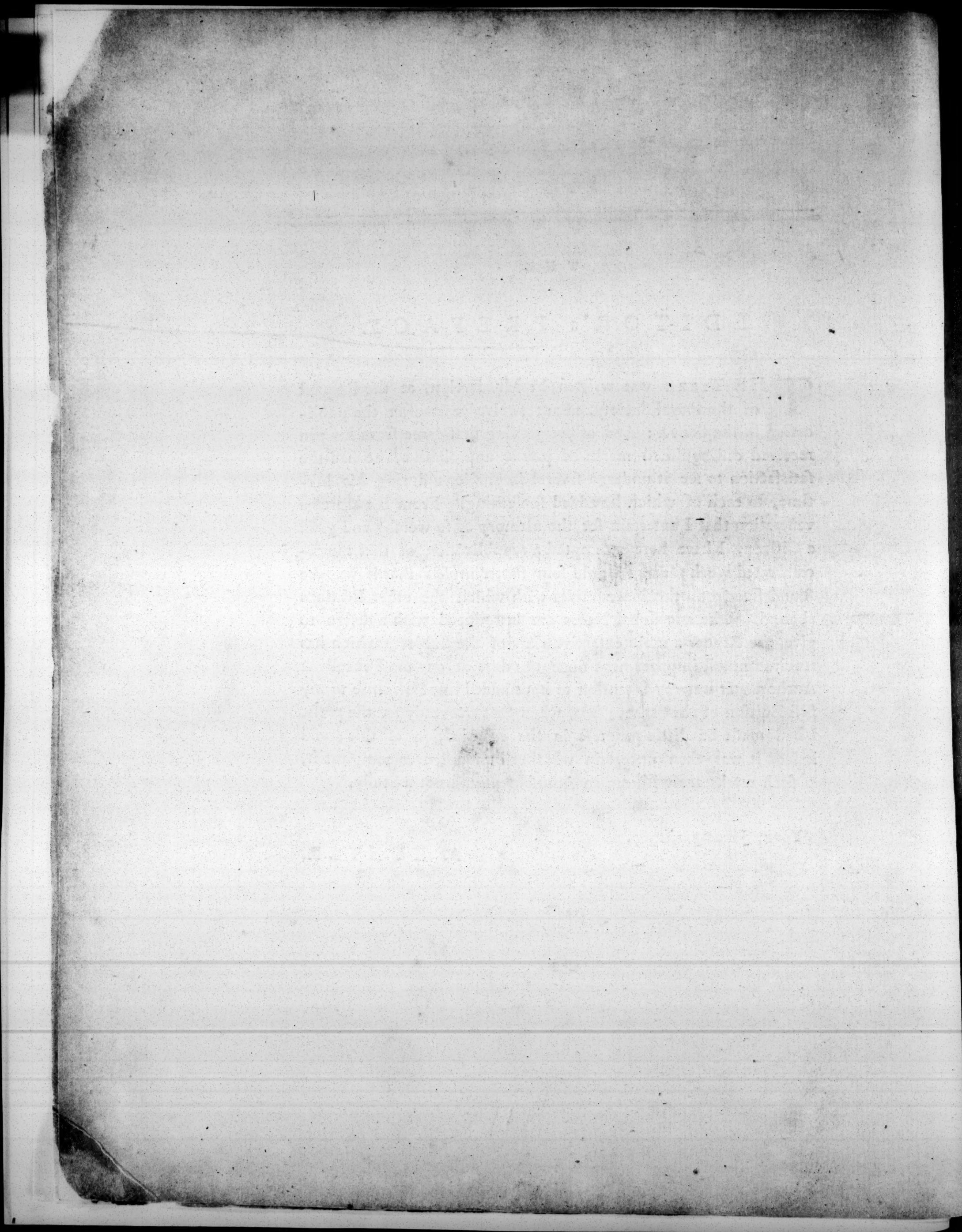
1753

T H E
E D I T O R ' s P R E F A C E .

THE TERRA was written by Mr. Evelyn, at the Request of the Royal Society, about twelve years after the publication of the SILVA : And as every thing that came from his pen received distinguished marks of public approbation, he had the satisfaction to see it undergo several impressions during his lifetime, to each of which he added something. From the extreme veneration that I entertain for the memory of so worthy and good a Citizen, I have here attempted a republication of that much-celebrated work ; and I would fain flatter myself that it will be found free from the inaccuracies with which the other Editions abound. The occasional Notes are introduced with a design to give the Reader a more extensive view of the Subject, which has received much improvement since the days of our most excellent Author. It was my intention to have added this Discourse to my first Edition of the SILVA ; but, when that was ready for the press, I had made but little progress in the examination of this ; and indeed it was then uncertain whether I should ever compleat it, as such works are with me an Amusement and not a Study.

YORK, January 1, 1787.

A. HUNTER.



TO
JOHN EVELYN, Esq.

S I R,

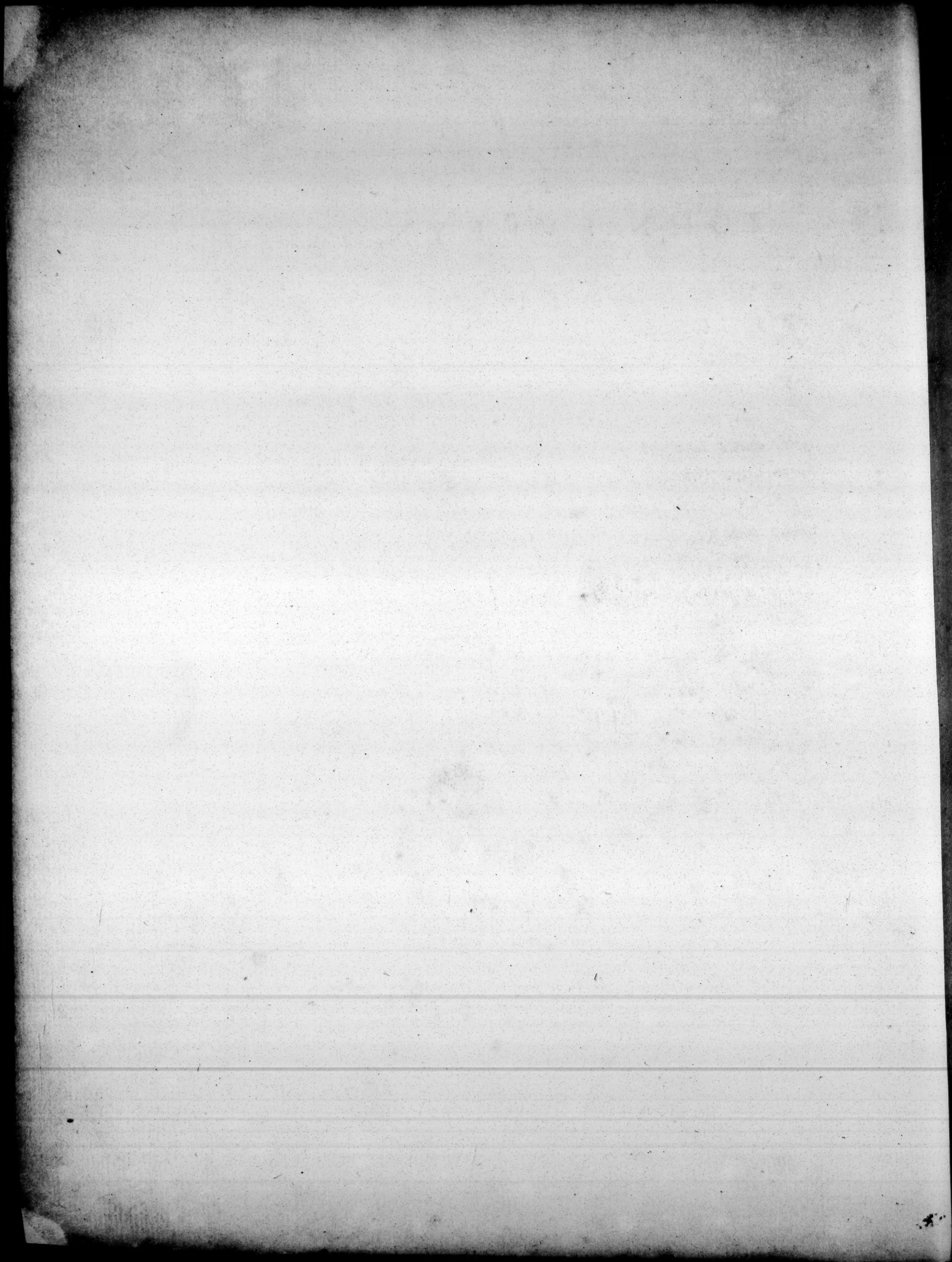
THE Council of the ROYAL SOCIETY, considering with themselves the great importance of having the Public Meeting of the said Society constantly provided with entertainments suitable to the design of their institution, have thought fit to undertake to contribute each of them One; not doubting but that many of the Fellows of the Society will join with them in carrying on such an undertaking: and being well persuaded of your approbation of this their purpose, (so much tending to the reputation and support of the Society) they desire that you would be pleased to undertake for One; and to name any Thursday after the fourteenth of January next, such as shall be most convenient for you, when you will present the Society, at one of their Public Meetings, by yourself, or some other of the Fellows for you, with such a Discourse (grounded upon, or leading to, Philosophical Experiments) on a subject of your own choice. In doing of which you will benefit the Society, and oblige,

S I R,

Your humble Servant,

LONDON, Dec. 28,
1674.

BROUNCKER, P.R.S.



To the Right Honourable
Lord Viscount B R O U N C K E R,
PRESIDENT OF THE
R O Y A L S O C I E T Y.

MY LORD,

I Have, in obedience to your Lordship, and the irresistible suffrages of that SOCIETY over which you preside, resigned these Papers to be disposed of as you think fit. I hear your Lordship's sentence is, they should be made public. Why should not a thousand things of infinitely more value, daily enriching their collection, (and which would better justify the laudable progress of that Assembly) be oftener produced, as some of late have been? This, my Lord, would obviate all unkind objections, and cover the infirmities of the present Discourse, with things indeed worthy our Institution. But, as I am to obey your Lordship's commands, so both your Lordship and the Society, are accountable for publishing the imperfections of,

My LORD,

Your Lordship's and

Their most obedient Servant,

APRIL 29, 1675.

J. EVELYN.

Jan

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T E R R A:
A
P H I L O S O P H I C A L D I S C O U R S E
O F
E A R T H.

I Am called upon by command from your Lordship, and the Council who direct the progress of the Royal Society, to entertain this Illustrious Assembly with something which, being either deduced from, or leading to, Philosophical Experiment, may be of real use, and suitable to the design of its institution.

I am highly sensible as of the honour which is done me, so of the great disadvantages I lie under for want of abilities to carry me through an undertaking of this importance, and before such acute and learned judges; but I hope my obedience to your commands will cover those defects for which I can make no other apology.

There are few here, I presume, who know not upon how innocent and humble a subject I have long since diverted my thoughts; and therefore I hope they will not be displeased, or think it unworthy of their patience, if from their more sublime and noble speculations (and which do often carry them to converse among the brighter Orbs and heavenly bodies) they descend a while, and fix their eyes upon the Earth, which I make the present argument of my discourse. I had once indeed pitched upon a subject of somewhat a more brisk and lively nature; for what is there in nature so sluggish and dull as Earth? What more spiritual and active than Vegetation, and what the Earth produces? But this, as a province becoming a more steady hand and penetrating wit than mine to cultivate, (unless where it transitorily comes in my way to speak of Salts and Ferments) I leave to those of this learned Society, who have already given such admirable Essays of what they will be more able to accomplish upon that useful and curious theme; and therefore I beg leave that I may con-

A

fine myself to my more proper element, the Earth, which, though the lowest and most inferior of them all, yet is so subservient and necessary to vegetation, as without it there could hardly be any such thing in nature.

To begin: I shall in the first place describe what I mean by Earth; then I shall endeavour to shew you the several sorts and kinds of Earth; and lastly, how we may best improve it to the uses of the husbandman, the forester, and the gardener; which is indeed of large and profitable extent, though it be but poor and mean in sound, compared to mines of gold and silver, and other rich ores, which likewise are the treasures of the Earth, but less innocent and useful.

I intend not here to amuse this noble audience, or myself, with those nice enquiries concerning what the real form of that body or substance is which we call Earth, denudated and stripped of all Heterogeneity, and reduced to its principles: as whether it be composed of sandy, central, nitrous or other salts, atoms, and particles: whether void of all qualities but dryness, and the like, (as they commonly enter into the several definitions of Philosophers) nor of what figure and contexture it consists, which causes it to adhere and combine together, so as to affirm any thing dogmatically thereupon; much less shall I contend whether it be a planet moving about the sun, or be fixed in the centre of the universe; all which have been the curious researches and velitations of our later Theorists; but content myself with that body or mass of glebe which we both dwell on, and every day cultivate for our necessary subsistence, as it affords us corn, trees, plants, and vegetables of all sorts, useful for human life, or the innocent refreshments of it.

Those who have written *de Arte Combinatoria*, reckon up no fewer than one hundred seventy-nine millions one thousand and sixty different sorts of Earths; but of all this enormous number, as of all other good things, it seems they do not acquaint us with above eight or nine eminently useful to our purpose; and truly I can hardly yet arrive at so many. Such as I find naturally and usually to rise from the pit, I shall here spread before you in their order.

The most beneficial sort of Mould or Earth, appearing on the surface, (for we shall not at present penetrate lower than is necessary for the planting and propagation of vegetables) is the natural under-turf Earth; but for a description of the rest which succeed it in strata, or layers, till we arrive at the barren and impenetrable rock, I shall refer the critical reader to the old Geoponic authors.

Most, or all, of these strata lying in beds one upon another, from softer to harder, better to worse, usually determine in sand, gravel, stone, rock, or shell; which last we frequently meet with in marshes and fenny delves, and sometimes even at the foot of high mountains, and sometimes on their very tops, after divers successions of different Moulds, and at the bottom of the profoundest pits, as in that deep perforation made at Amsterdam, in order to the building of the Stadt-House*. All which, and the cause of the successions of the several strata of fossils, &c. so bedded thro' the whole terrestrial globe, the ingenious Dr. Woodward attributes to a total dissolution of the materials which constituted the original fabrick of the Antediluvian World, when the commotion of the waters beginning to calm and relax, the disunited floating particles promiscuously blended, sunk down, and subsiding according to their specific gravities,

N O T E S.

* Varenius informs us, that in a well which was dug at Amsterdam to the depth of two hundred and thirty-two feet, the following substances were found in succession: seven feet of vegetable earth; nine of turf; nine of soft clay; eight of sand; four of earth; ten of clay; four of earth; ten of sand; two of clay; four of white sand; five of dry earth; one of soft earth; fourteen of gravel; eight of clay mixed with sand; four of gravel mixed with shells; an hundred and two feet of clay, and then thirty-one feet of sand.—Mr. Buffon, in the first volume of his Natural History, gives us still a more exact enumeration of the different beds of earth found at Marly-la-Ville, to the depth of one hundred and one feet.

	Feet	Inch.
1. A free reddish earth, with much vegetable mould, a very small quantity of vitrifiable sand, and somewhat more calcinable sand or gravel - - -	13	0
2. A free earth mixed with more gravel, and a little more vitrifiable sand - - -	2	6
3. Earth mixed with vitrifiable sand in a very great quantity, and which made but very little effervescence with aqua fortis - - - - -	3	0
4. Hard marble, which made a very great effervescence with aqua fortis - - -	2	0
5. Very hard marly stone - - - - -	4	0
6. Marl in powder, mixed with vitrifiable sand - - - - -	5	0
7. Very fine vitrifiable sand - - - - -	1	6
8. Earthy marl, mixed with a little vitrifiable sand - - - - -	3	6
9. Hard marl, in which was real flint - - - - -	3	6
10. Gravel, or powdered marl - - - - -	1	0
11. Eglantine, a stone of the grain and hardness of marble, and sonorous - - -	1	6
12. Marly gravel - - - - -	1	6
13. Marl in the form of hard stone, whose grain was very fine - - - - -	1	6
14. Marl like stone, with a grain not so fine - - - - -	1	6

Carried over 45 0

settled in the beds and strata we now every where find. But of this, and other effects of the deluge, see the learned Doctor's Essay *.

I begin with what commonly first presents itself under the removed turf, and which, for having never been violated by the spade, or received any foreign mixture, we will call Virgin-Earth; not that of the Chymists, and the searchers after the Philosopher's Stone, but what is found lying about a foot deep, more or less, in our fields, before we come to any manifest alteration of colour or perfection. This Surface-Mould is the best and sweetest, being enriched with all that the air, dews, showers, and celestial influences can contribute to it: for it is with good Earth as with excellent water; that is the best which with least difficulty receives all external qualities; for the fatness of this under-turf Mould, being

N O T E S.

	Feet	Inch.
Brought over	45	0
15. Marl still more gross - - - - -	2	6
16. Very fine vitrifiable sand, mixed with fossil sea shells, which had no ad- herence with the sand, and whose colours and polish were perfect - - - - -	1	6
17. Very small gravel, or fine marl powder - - - - -	2	0
18. Marl in the form of hard stone - - - - -	3	6
19. Coarse powdered marl - - - - -	1	6
20. Hard stone, calcinable like marble - - - - -	1	6
21. A gray vitrifiable sand, mixed with fossil shells, particularly oysters and muscles, which had no adherence with the sand, and which were not petrified	3	0
22. White vitrifiable sand mixed with the like shells - - - - -	2	0
23. Sand streaked red and white, and mixed with the like shells - - - - -	1	0
24. Larger vitrifiable sand, mixed with the like shells - - - - -	1	0
25. A fine gray, vitrifiable sand, mixed with the like shells - - - - -	8	6
26. Very fine fat sand, with very few shells - - - - -	3	0
27. Brown free stone - - - - -	3	0
28. Vitrifiable sand, streaked red and white - - - - -	4	0
29. White vitrifiable sand - - - - -	3	6
30. Reddish vitrifiable sand - - - - -	15	0
Total depth	101	0

* In the year 1695, Dr. Woodward published his celebrated work, entitled "An Essay towards a Natural History of the Earth," of which Mr. Evelyn has here given us a very just and concise account. The Doctor's theory met with many warm opponents, which obliged him to engage deeply in the defence of it; and so fondly was he attached to his doctrine, that he founded a Lecture in the University of Cambridge to be read there in defence of it, which he endowed with a salary of one hundred pounds per annum. The ingenious and learned Dr. Middleton was appointed the first Lecturer.

drawn up by the kindly warmth of the sun to the superficies, spends but little of its vigor in the grafs and tender verdure which it produces, and easily nourishes without dissipating its virtue, provided no rank weeds or predacious plants (consummating their seeds) be suffered to grow and exhaust it, but maintains its natural force, and is therefore of all other uncultivated Moulds the most grateful to the husbandman *.

Now as the rest of incumbent and subjacent Earths approach this in virtue, so are they to be valued; and of these there are several kinds, distinguishable by their several constitutions; the best of which is black, fat, yet porous, light, and sufficiently tenacious, without any mixture of sand or gravel, rising in pretty gross clods at the first breaking up of the plough; but with little labour and exposure falling to pieces, but not crumbling altogether into dust, which is the defect of a more vicious sort. Of this excellent black Mould, fit almost for any thing without much manure, there are three kinds, which differ in hue and goodness.

The next layer in series to this is usually mixed with a sprinkling of stones, somewhat hard, yet friable, and, when well aired and stirred, is not to be rejected; the looseness of it admitting the refreshment of showers, renders it not improper for trees and plants which require more than ordinary moisture. Declining from this in perfection, is the darkish grey or tawny, which, the deeper you mine, rises veined with yellow, and sometimes reddish, till it end in pale; and if you penetrate yet farther, commonly in sand and a gritty stone.

Of a second class, is Mould of an obscure colour also, more delicate grain, tender, cheffon and mellow; clear of stones and grittiness, with

N O T E S.

* With this loose covering the Earth is every where invested, unless it be washed off by rains, or removed by some other external violence. "It is the Earth that, like a kind mother, receives us at our birth, and sustains us when born. It is this alone, of all the elements around us, that is never found an enemy to man. The body of waters deluge him with rains, oppress him with hail, and drown him with inundations; the air rushes in storms, prepares the tempest, or lights up the volcano; but the Earth, gentle and indulgent, ever subservient to the wants of man, spreads his walks with flowers, and his table with plenty; returns with interest every good committed to her care; and though she produces the poison, she still supplies the antidote; though constantly teased more to furnish the luxuries of man than his necessities, yet, even to the last, she continues her kind indulgence, and when life is over, she piously hides his remains in her bosom." *Plin. Nat. Hist.* l. ii.

an eye of loam and sand, which renders it light enough, yet moist; of all other the most desirable for flowers and the coronary garden.

To this we add a yet more obscure and sandy Mould, accompanied with a natural fatness; and this, though rarer, is incomparable for all sorts of fruit-trees.

A third participates of both the former; fattish, yet interspersed with small flints and pebbles, not to be altogether neglected.

A fourth is totally sandy, and that of divers colours, with sometimes a bottom of gravel, now and then rock, and not seldom clay; and, as the foundations are, so it is more or less retentive of moisture, and tolerable for culture; but all sand does easily admit of heat and moisture, and yet for that not much the better; for either it dismisses and lets them pass too soon, and so contracts no ligature, or retains them too long, especially where the bottom is of clay, by which it parches, or chills, producing nothing but moss, and disposes to cankerous infirmities; but if, as sometimes it fortunes, that the sand have a surface of more genial Mould, and a bottom of gravel or loose stone, though it do not long maintain the virtue it receives from heaven, yet it produces forward-springing, and is parent of sweet grass, which, though soon burnt up in dry weather, does as soon recover with the first rain that falls.

Of pure and sheer sand there is white, black, bluish, red, yellow, harsher and milder, and some meer dust in appearance, none of them to be desired alone; but the grey-black and ash-coloured, and that which frequently is found in heathy commons, or of the travelling kind, volatile, and exceeding light, is the most insipid and worst of all. I do not here speak of the drift and sea sand, which is of admirable virtue and use in mixtures, and to be spread on some lands, because it has been described so accurately already in a just discourse upon another occasion, by an experienced Gentleman dwelling in the western parts, where this manure is perfectly understood, and recommended to more general use.

As of sands, so are there different sorts of clays, and of as different colours, whereof there is a kind so obstinate and ill-natured, as almost nothing will subdue; and another so voracious and greedy, as nothing will satiate, without exceeding industry, because it ungratefully devours all that is applied to it, turning it into as arrant clay as itself. Some

clays are more pinguid than others; some more slippery; all of them tenacious of water on the surface, where it stagnates and chills the plant, without penetrating; and in dry seasons costive, and hardening with the sun and wind; most of them pernicious and untractable.

The unctuous and fatter clay frequently lies upon the other, having oftentimes a basis of chalk beneath it; but neither is this worth any thing till it be loosened and rendered more kind, so as to admit of the air and heavenly influences: in a word, the blue, white, and red clays (if strong) are all unkind; the stony and looser sort is yet sometimes tolerable; but the light Brick-Earth does very well with most fruit-trees.

I had almost forgotten Marsh-Earth, which, though of all other seemingly the most churlish, a little after it is first dug and dried, (when it soon grows hard and chaps) may, with labour and convenient exposure, be brought to an excellent temper; for being the product of rich slime, and the sediment of land-waters and inundations, which are usually fat, as also the rotting of sedge, yea, and frequently of prostrated trees, rotted and now converted into Mould, it becomes a very profitable land; but whether I may reckon this among the natural Earths, I do not contend.

Of Loams and Brick-Earths we have several sorts, some approaching to clay, others nearer marl; differing also in colour; and if it be not too rude, mingled in just proportion with other Mould, an excellent ingredient in all sorts of Earth, and so welcome to the husbandman, and especially the gardener, as nothing does well without a little dash of it.

Of Marl (a substance between clay and chalk, of a cold, sad nature) we have seldom such quantities in layers as we have of the forementioned Earths; but we commonly meet with it in places affected to it, and it is taken out of pits at several depths, and of divers colours, red, white, grey, blue, all of them unctuous, of a slippery nature, and differing in goodness; for, being pure and immixed, it sooner relents after a shower, and when dried again, slackens and crumbles into dust, without induration, and growing hard. All the kinds are profitable for barren grounds, as abounding with nitre*.

N O T E S.

* Whoever is desirous of obtaining a just and philosophical idea of marl, may consult Dr. Ainslie's account of that substance, as inserted in the *Georgical Essays*. In the same work there is a most useful Essay by the ingenious Mr. Henry, of Manchester, on the manner of compounding *factitious* marl for the use of such farmers as reside in countries where genuine marl cannot be obtained.

Lastly, Chalk. This is likewise of several kinds and colours; hard, soft, fine, coarse, abstergent, slippery, and marly, and apt to dissolve with the weather into no unprofitable manure. Some kinds have a sandish, others a blacker and slight surface; and there is a sort which produces sweet grass and aromatic plants, and some so rank, especially in the vallies of very high hills, as to feed not only sheep, but other cattle, to great advantage, as we may see in divers places among the downs of Suffex. But it has a peculiar virtue above all this, to improve other lands, as we shall come to shew.

I forbear to speak particularly of Fullers Earth, Tobacco-pipe Clay, dry and astringent, the white Cimolia, and the several fictile clays, because they are not so universal and serviceable to the plough and spade; much less of Terra Lemnia, Chia, Melitenis, Hetrusca, and the rest of the Sigillatæ; nor of the Boles, Rubrics, and Okers, Figuline, Stiptic, Smegmatic, &c. as they are diversly qualified for several uses, medicinal and mechanical, but content myself with those I have already enumerated*.

N O T E S.

* Earths consist of very minute and almost impalpable particles, cohering very slightly together. They do not burn, nor are they malleable; are easily diffusible, but not soluble, in water. Properly there are but two sorts:

- I. *Argillaceous Earths*, which harden in the fire, and do not dissolve in the mineral acids.
- II. *Alcaline, or Calcareous Earths*, which in the fire burn to lime, and dissolve in the mineral acids.

ARGILLACEOUS EARTHS consist either of spongy, or of smooth tenacious parts: the former is called *Vegetable Earth*, or *Mould*; the latter, *Clay*.

Among the CLAYS are reckoned

I. *Potters Earths*, viz.

1. Loam, which is coarse, irony, and very sandy.
2. Common potters clay, which is heavy, without sand, of different substance and colour, whence some require a greater degree of heat to flux them than others.
3. Fine clay, or porcelain clay, which is smooth and greasy to the touch, and of various colours.

II. *Medicinal Earths*, viz.

1. Boles and Terræ Sigillatæ.

III. *Mechanical Earths*, viz.

1. Tripoli.
2. Fullers Earth, which lathers like soap, and raises a froth in the water. But the true Fullers Earth dissolves in acids, and consequently belongs to the Marl-Earths.

O F E A R T H.

Now, besides the description and characters we have given of these several Moulds and Earths, as they reside in their several beds and couches, there are divers other indications, by which we may discover their qualities and perfections; as, amongst others, a most infallible one is, their disposition to melt and crumble into fine morsels, not to turn mud and mortar, upon the descent of gentle showers, how hard soever they seem before, and if in stirring they rise rather in granules, than massy clods.

N O T E S.

IV. *Painters Earths*, viz.

- | | | |
|--|--|---|
| 1. White.
2. Mineral yellow.
3. Umber. | | 4. Mineral red.
5. Mineral blue.
6. Mineral green |
|--|--|---|

To the ALKALINE or CALCARIOUS EARTHS belong the following:

- I. *Chalk*. This is composed of fine particles, adhering closely together, and forming a pretty compact texture. It colours the hand upon being touched, and commonly is white, but sometimes is of different colours and kinds.
- II. *Marls*. These are of a loose, friable texture, easily reducible into powder, and readily separating and diffusing in water. When recently dug out of the ground, they are pretty hard, but being exposed to the air, soon fall into powder. They are of various colours, but are seldom pure, being commonly mixed with a portion of argillaceous Earth.

*** As *Stones* are intimately connected with *Earths*, I shall in this place give a general idea of them, in order that the reader may have a full and comprehensive view of that mixed body, which is the subject of this Essay.

STONES may be comprehended under the four following genera:

- I. *Calcareous*, or *Lime Stones*.
 1. These effervesce with, and dissolve in the mineral acids; and in the fire burn to lime.
- II. *Argillaceous* or *Clay Stones*.
 1. These are insoluble in acids, and burn to hardness in the fire.
- III. *Gypseous*, or *Plaster Stones*.
 1. These are not affected by acids. They burn to plaster in the fire, and being wetted with water, presently grow hard, in which they differ from lime, which does not harden upon wetting, unless mixed with sand, and not then till after a long time.
- IV. *Vitrescent*, or *Glass Stones*.
 1. These suffer no change with acids, and in the fire run to glass. All this genus strike fire with steel, except the glass spar and the pumice stone.

*** A great many small, visible, vitrescent *Stones*, constitute what is called *Sand*, which is either coarse or fine. Sometimes *Sand* consists of one species only, but oftener of two or more. When these cohere, they form the *Grit* or *Sand-Stone*, of which *Mill-Stones*, *Grind-Stones*, &c. are made.

If upon excavating a pit, the mould you exhaust do more than fill it again, Virgil tells us 'tis a good augury; upon which Laurembergius affirms, that at Wittemberg, in Germany, where the Mould lies so close, as it does not replenish the fofs out of which it has been dug, the corn which is sown in that country soon degenerates into rye; and what is still more remarkable, that the rye sown in Thuringia (where the earth is less compacted) reverts, after three crops, to be wheat again*.

My Lord Bacon directs to the observation of the Rainbow, where its extremity seems to rest, as pointing to a more roscid and fertile mould; but this, I conceive, may be very fallacious, it having two horns, or bafes, which are ever opposite.

But the situation and declivity of the place is commonly a more certain mark; as what lies under a Southern, or South-East rising ground; but this is also eligible according to the purposes you would employ it for; some plants affecting hotter, others colder exposures; some delight to dwell on the hills, others in the vallies and clofer seats; and some again are indifferent to either; but, generally speaking, most of them choofe the warm and more benign; and the bottoms are univerfally fertile, being the recipients of what the showers bring down to them from the hills and more elevated parts.

Another infallible indication is the nature and floridness of the plants which the land naturally produces; as where thistles spontaneously thrive; where the oak grows tall and spreading; and as the plant is of kind, so to prognosticate for what tillage, or other use, the ground is proper. Thyme, strawberries, betony, and sorrel, direct to wood; chamomile, to a Mould disposed for corn and hortulan furniture; burnet, to pasture; mallows, to roots, and the like, as my Lord Verulam and others observe.

On the contrary, some grounds are so cold as naturally to bring forth nothing but gorse, broom, holly, yew, juniper, ivy, and box, which may happily direct us to the planting of pine, firs, the phillyreas, laurel, Spanish broom, and other perennial verdures, in such places.

N O T E S.

* This observation of Laurembergius has neither reason nor experiment to recommend it. It is in the last degree absurd.

Moss, rushes, wild tanfy, sedge, flags, fern*, yarrow, and where plants appear withered or blasted, shrubby and curled, (which are the effects of immoderate wet, heat and cold, interchangeably) are natural auguries of a cursed soil; yet I have observed some ferny grounds proper enough for coppice and forest-trees. Thus, as by the plant we may conjecture of the Mould, so by the Mould we may guess at the plant; the more herbaceous and tender, springing from the gentle bed; the coarser and rougher plants, from the rude and churlish. And as some Earths appear to be totally barren, and some, though not altogether so unfruitful, yet wanting salacity to conceive, vigor to produce, and sensibly eluding all our pains, so there are others which are perpetually pregnant; and this is likewise a good prognostic.

Upon these, and such like hints, in proposals of transplanting spices and other exotic rarities from either Indies, the curious should be studious to procure of the natural Mould in which they grow, (and this might be effected to good proportion, by the ballasting of ships) either to plant or nourish them in from the seed, till they were of age, and had gained some stability of roots and stem, and become acquainted with the genius of our climate; or for essays of mixtures, to compose the like.

By the goodness, richness, hungriiness, and tincture of the water straining through grounds, and by the weight and sluggishness of it, compared with the lighter, conjecture also may be made, as in part we have shewed already.

To conclude: There are almost none of our senses but may of right pretend to give their verdict here.

And first, we judge by the odour or smell, containing, as my Lord Verulam affirms, the juice of vegetables already, as it were, concocted and prepared; so as after long droughts, upon the first rains, good and natural Mould will emit a most agreeable scent, and in some places (as Alonso Barba, a considerable Spanish author, testifies) approaching the

N O T E S.

* Where fern grows luxuriantly, we may pronounce the soil favourable to turnips, corn, and trees. The other plants here mentioned are certain indications of a bad soil.—Virgil describes sterile grounds by enumerating the plants that naturally grow in such places. There,

—— piceæ tantum, taxique nocentes

Interdum, aut hederæ pandunt vestigia nigræ. GEORG. ii.

most ravishing perfumes; on the contrary, if the ground be disposed to any mineral, or other ill quality, it sends forth arsenical and very noxious steams, as we find in our marshes and fenny grounds.

2dly, By the taste, and that with good reason, all Earths abounding more or less in their peculiar salts, as well as plants; some sweet and more grateful; others bitter, mordacious, or astringent; some flat and insipid; all of them to be detected by percolation of untainted water thro' them; though there be who affirm that the best Earth, like the best water and oil, has neither odour nor taste.

3dly, By the touch, if it be tender, fatty, deterfive, and slippery; or more asperous, gritty, porous, and friable; likewise if it stick to the fingers like bird-lime, or melt and dissolve on the tongue like butter. Furthermore, good and excellent Earth should be of the same constitution, and not of contrary, as soft and hard, churlish and mild, moist and dry; not too unctuous, nor too lean, but resolvable, and of a just and procreative temper, combining into a light easily crumbling Mould, yet consistent, and apt to be wrought and kneaded; such having a modicum of loam naturally rising with it, to entertain the moisture, does neither defile the fingers nor cleave much to the spade, which easily enters it: This kind is usually found under the turf of pasture grounds, upon which cattle have been long fed and foddered. In a word, that is the best Earth to all the senses which is of a blackish grey, cuts like butter, sticks not obstinately; but is short, light, breaking into small clods, is sweet, will be tempered without crusting or chapping in dry weather, or becoming mortar in wet.

Lastly, By the sight, from all the instances of colour and other visible indications; for the common opinion is, though exploded by Columella, that all hot and choleric grounds are red or brown; cold and dry, blackish; cold and moist, whitish; hot and moist, ruddy; which yet, exhalations from minerals, the heat of the sun, and other accidents may cause; but generally they give pre-eminence to the darker greys; next to the russet; the clear tawny is found worse; the light and dark ash-colour (light also of weight, and resembling ashes) good for nothing; but the yellowish red worst of all. And all these are fit to be known, as contributing to noble and useful experiments, upon due and accurate comparisons and enquiries from the several particles of their constitutions, figures, and modes, as far at least as we can discover them by the best auxiliaries

of microscopes, lotions, strainers, calcinations, and grindings; upon such discovery to judge of their qualities, and by essaying variety of mixtures, and imitating all sorts of Mould, foreign or indigen, to compound Earths as near as may be resembling the natural, for any special or curious use, and thereby be enabled to alter the genius of grounds as we see occasion*.

The consideration of this it was which gave me the curiosity to fall upon the examining of a collection I had made of several sorts of Earths

N O T E S.

* I cannot in this place omit the beautiful and correct description that Virgil has given us of the various soils.

Next, of each various soil the genius hear!
 Its colour, strength, what best dispos'd to bear.
 Th'unfriendly cliffs, and unprolific ground,
 Where clay jejune, and the cold flint abound,
 Where bushes overspread the barren field,
 Will best th'unfading grove of Pallas yield:
 Here the wild olive woods luxuriant shoot,
 And all the plains are strewn with sylvan fruit.
 But the rich Soil with genial force endu'd,
 All green with grass, with moisture sweet bedew'd,
 Such as we oft survey from cavern'd hills,
 Whence many a stream descends in dripping rills,
 And with rich ooze the fatt'ning valley fills;
 Or that which feels the balmy southern air,
 And feeds the fern unfriendly to the share;
 Ere long will vines of lustiest growth produce,
 And big with bounteous Bacchus' choicest juice,
 Will give the grape in solemn sacrifice,
 Whose purple stream the golden goblet dyes,
 When the fat Tuscan's horn has call'd the god,
 And the full chargers bend beneath the smoking load.
 But bullocks would you rear, and herds of cows,
 Or sheep, or goats that crop the budding boughs;
 Seek rich Tarentum's plains, a distant coast,
 And fields like those my luckless Mantua lost,
 His silver-pinion'd swans where Mincio feeds,
 As slow they sail among the wat'ry weeds.
 There for thy flocks fresh fountains never fail,
 Undying verdure cloaths the grassy vale;
 And what is crop'd by day, the night renews,
 Shedding refreshful stores of cooling dews.

and Soils, such as I could find about this territory, whereof some I washed, to find by what would melt, reside, or pass away in the percolation, of what visible figure they chiefly seemed to consist, armed as I was with an indifferent microscope, of which he pleased to take this brief account.

Gravelly and arenous Earths of several sorts, before they were washed, appeared to consist mostly of rough crystals, of which some were very transparent and gemmy; few of them sharp or angular, but roundish and mixed with particles of a mineral hue, which being well dried, and bruised

N O T E S.

A fable Mould and fat beneath the share,
That crumbles to the touch, of texture rare,
And (what our art effects) by nature loose,
Will the best growth of foodful grain produce:
And from no field, beneath pale evening's star
With heavier harvests fraught, returns the nodding car.
Or else the plain, from which the plowman's rage
Has fell'd the forest, hoar through many an age,
And tore the tall trees from their ancient base,
Long the dark covert of the feathery race;
Banish'd their bow'rs, abroad they mount in air,
While shines the recent glebe beneath the share.
For the lean gravel of the sloping field,
And mould'ring stones, where snakes their mansions build,
Where in dark windings, filthy reptiles breed,
And find sweet food their lurking young to feed;
To bees ungenial, scarcely will supply
Their Cassia-flow'rs, and dewy rosemary.
In that blest ground, which from its opening chinks,
At will a steaming mist emits, or drinks;
Which blooms with native grasses for ever fair,
Nor blunts with eating rust the sliding share,
Round thy tall Elms the joyous vines shall weave;
And floods of luscious oil thy olives give;
This, with due culture, thou shalt surely find
Obedient to thy plow, and to thy cattle kind.
Such fertile lands rich Capua's peasants till,
And such the soil beneath Vesuvius' hill;
And that, where o'er Acerrae's prostrate tow'rs
Clanius his swelling tide too fiercely pours.

Rules to know different soils I next dispense;
How to distinguish from the rare the dense.

on a hard serpentine stone, and mullar of the same, was with little labour reduced to an impalpable whitish sand, untransparent, as it happens in the bruising of most bodies, though never so diaphanous before.

Yellow sand had the appearance of amber; but, when bruised, it became a paler untransparent sand.

Fat rich Earth, full of black spots, without much discolouring the water, (as hardly did any of the sands) being dried, was reduced to a delicate sandy dust, with very little brightness.

N O T E S.

This best for vines, that golden grain approves,
 Ceres, the dense; the rare, Lyaeus loves.
 First chuse a spot that's for the purpose fit,
 Then dig the solid earth, and sink a pit;
 Next, to its bed th'ejected soil restore,
 And press with trampling feet the surface o'er;
 If the Mould fail, 'tis light; that soil inclines
 To fatten herds, and swell thy cluster'd vines.
 But o'er the pit replenish'd, if the ground
 Still rise, and in superfluous heaps abound,
 O'er the thick glebe let sturdy bullocks toil,
 Cleave the compacted clods and sluggish soil.
 The land that's bitter, or with salt imbu'd,
 Too wild for culture, for the plow too rude,
 Where apples boast no more their purple hues,
 And drooping Bacchus yields degen'rate juice,
 May thus be known: Of twigs a basket twine
 Like that from whence is strain'd the recent wine;
 This with the soil and crystal water fill,
 Then squeeze the mass, while thro' the twigs distil
 The big round drops in many a trickling rill;
 Soon shall its nature from its taste appear,
 And the wry mouth the bitter juice declare.
 We learn from hence a fat and viscid land;
 It sticks like pitch uncrumbled to the hand:
 The moister Mould a rank luxuriance feeds,
 Of lengthen'd grass, and tall promiscuous weeds;
 O may be mine no over-fertile plain,
 That shoots too strongly forth its early grain!
 The light and heavy in the balance try,
 The black and other colours strike the eye;
 Not so the cold; lo! there dark ivy spreads,
 Or yews or pitch-trees lift their gloomy heads.

WARTON.

Marsh Earth contained a considerable quantity of sand, the rest resembled the fat Earth.

The under-pasture Mould had likewise a sandy mixture, and what passed with the water after evaporation, seemed to be an impalpable and very fine untransparent sand.

Clay consisted of most exceeding smooth and round sands of several opacous colours.

Potters Earth, of different sorts, ground small, became like sand, of a yellowish grey and other colours, exceeding polite and smooth.

A certain yellowish loamy Earth, which had been brought to me with some orange-trees out of Italy, was reduced to a bright soft sand, appearing more gemmy than in the other loams.

Chalk resembled fine white flour, and some of it sparkled, especially the harsher sort; but the tender, not.

Fullers Earth appeared like Gum Tragacanth; a little wetted, seemingly swelled, yet glittering; but, when reduced to a fine dust, became a smooth sand.

Tobacco-pipe Earth, not much bruised, was just like white starch; washed and well dried, it resembled the whitest flour of wheat a little candied. I had not the opportunity of examining the several sorts of marls; so I proceed to the dungs.

Neats-dung (the cattle fed only with fodder, or little grass, for it was in the winter I made my observations) appeared to be nothing but straws in the entire substance, and colour little altered, save what a certain slippery mucilage gave them, sprinkled with a glittering sand like atoms of gold; but, upon washing and drying again, the tenacious matter vanished, and the straws appeared separated and clear.

Sheeps-dung was much like the former, only the spires and blades of a fine short grass were conglomerated and rolled up into pellets, about which the glew was less viscous, but it passed also away in the lotion.

Swines-dung had the resemblance of dirty bees wax, mingled with straws and husks, which seemed like candied Eringo, and some like Angelica roots.

The soil of horses appeared like great wisps of hay and little straws, thin of mucilage, and which, being washed, was easily to be discerned by a naked eye.

Deers-dung much resembled that of sheep.

Pigeons-dung consisted of a stiff glutinous matter, easily reducible to dust of a grey colour, with some husky atoms, after dilution. Lastly,

The dung of poultry was so full of gravel, small stones, and sand, that there appeared little or no other substance, save a very small portion both of white and blackish viscous matter twisted up together. This, of all others, the moist foetid and ill smelling.

These were all I had time and leisure to examine: I cannot say with all the accurateness they were capable of, but sufficiently to encourage the more curious, and to satisfy myself, that the very finest Earth and best of Moulds, however to appearance mixed with divers imperfect bodies, may, for ought we know, consist more of sandy particles than of any other whatsoever, at least if from this criterion we may be allowed to pronounce what they seem to the eye, sands, crystals, or salts, call them what you please; the consideration of which being so universally the cause of vegetation, was no small inducement to me to see if, by examining the several Earths, (though but by a cursory inspection) I might possibly detect what rudiments of such a principle there were lurking in them, abstractedly taken; not that I think Earth to be salt alone, and nothing else, (though perhaps little more besides the sulphur) for so it produces no vegetable that I know of, without water to dissolve and qualify it for insurrection, and perhaps some other vegetable matter, fitted to manure and receive the seeds, and keep the plant steady, which yet, for ought I can discern, is also but a finer sort of sand, the clamminess of it being rather something extrinsecal and accidental to it, than any thing natural, and originally constitutive: for, the combination of these several Moulds which gives the ligature, slipperiness, and a diverse temper, seems rather to be caused by the perpetual and successive rotting of the grass, plants,

leaves, branches, moss, &c. (than any peculiar or solitary principle apart) which, in long tract of time, has amassed together a substance heterogeneous to the ruder particles, which after the dilutions of the superficies (that is, of the rich and fatter Mould) appears to be little other than sand, or fixed salts, of various figures and colours; since even the most obdurate and flinty pebble beaten and grownd to powder, or by calcination reduced to an impalpable dust, is as fine both to the eye, and smooth to the touch, as the most smectic Earths and marls themselves; such at least as you shall collect from the subsidence (to appearance) of the most crystal waters, precipitated by deliquated oil of tartar, or the like; and the more they be subdued and broken, the harder they will prove, if (cleared of their nitrous parts) they pass the potter's fire, however they seemed before to be of different constitution. This is evident in vessels made of tobacco-pipe clay, or whatever the material be, which has of late been so successfully employed by Dr. Hook, a worthy member of this Society, for the finding out a composition (if I may so call it) nothing inferior to the hardest porcelain, and almost as beautiful. And now upon contemplation of that almost universal ingredient, sand, through all our trials, I cannot but incline to the sentiment of that excellent philosopher, as well as physician, the learned Dr. Lister, that sand might be the first mantle and universal covering of the newly-created Earth. *See his discourse upon a map, discovering sands and clays, reduced to tables, presented to the Royal Society* *.

But to return to our superficial Earth, which we call the Mould: I affirm it to grow and increase yearly in depth from the causes aforesaid; and, in some places, to that proportion as to have raised no inconsiderable hills and eminences by the accidental fall and rotting of woods and trees,

N O T E S.

* Dr. Lister was of opinion, that, by examining the Earth from the surface downwards, as often as an opportunity offered, a pretty just theory might be formed of its contents in general: for it appeared from his own observations that upper natural soils infallibly produce the same internal minerals and materials. He has thrown out an hint to every naturalist for extending this useful knowledge, by advising that a soil or mineral map should be made, properly distinguished into countries, and enriched with observations for general use, arising from remarks on the bounds and produce of every particular soil.—The Doctor likewise thought that sand was once the exterior and general cover of the surface of the whole Earth, and that clay was another coat in the more depressed and hollow parts. The following are his Tables of Sands and Clays which he drew up in 1673, from observations made in the northern parts of England, and is the matter here referred to by Mr. Evelyn.

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A TABLE of SANDS.

Sharp, or Rag Sand, composed of small transparent pebbles, naturally found upon the mountains, not calcinable.		
Sand	Fine	White { Stitneham-Moor in the road washed up very white pebble, Flamborough-Head, of which the light-house there is cemented.
		Grey { Calais Sand burns reddish, but falls not in water. Seaton Banks near Hartlepool, on the Teese mouth. Escrik in the gravel-pit there; a vein of exceeding fine Sand.
		Reddish { The Pillow-Sand in the Baltick.
		Brown { In a spring at Hellington. The Sand at the Bath in Somersetshire. Acomb near York, drifted Sand.
	Coarse	Grieffly { Hutton Moor washed. Thorp Fells.
		{ Ouse at York. Nid at Mountain.
		Brown { Dug up at Rawcliff near Snaith. Wharfe at Ickly and Denton. Aire at Carleton in Craven. Ure at Craven. Ganton. Santon in Lincolnshire. Bromeby Common. Skipwith Common.
	Soft, or smooth with flat particles {	
	From lime- stone, with mica of different particles. { At—in Yorkshire. A vein at Oswell- Bacon in Lincolnshire.	
Of Westmorland.	Silver-like {	Sea-Sand about the Scilly islands. In Cleveland, and about Scarborough. Ouse dust or sediment at Rawcliff.
	Gold-like {	A vein of mica in Hellington gravel-pit. Mica argentea in Red-Sand Rock near Ripon, plentifully.
		Mica aurea of Cleveland.

Pure, that is, such as is soft like butter to the teeth, and has little or no grittiness in it.

Greasy, to be reckoned amongst the medicinal earths, or *terræ sigillatæ*.

1. Fuller's earth.

Yellowish. { At Brickhill in Northamptonshire.
At———under the Yorkshire Wolds.

Brown, about Halifax.

White, in the Derbyshire lead-mines.

2. Boli { In Cleveland.

At Linton upon Wharfe.

3. Pale yellow, in the marl-pit at Ripley.

4. Cow-shot Clay, or the soap-scale lying in coal-mines.

5. A dark blue Clay, or marl, at Towthorp.

Harsh and dusty when dry.

6. Creta, properly so called, or the milk-white Clay of the Isle of Wight.

7. The potter's pale yellow Clay of Wakefield Moor.

8. The blue Clay of Bullingbrook pottery in Lincolnshire.

9. A blue Clay of Bugthorp Beck, in which the *astroites* are found.

10. Yellow Clay in the seams of the red sand rock at Bilbro'.

11. Fine red Clay in the red sand rock at Bilbro' and Ripon.

12. A soft chalky blue Clay { at Buttercramb.

13. A soft chalky red Clay {

Stony when dry.

14. A red stone Clay. { In the banks of Whitear-Beck,

15. A blue stone Clay. { near Leppington, and at Housam in the Milscar.

16. Clunch, a white stone Clay in Cambridgeshire.

With round sand, or pebble.

17. The yellow Loam of Skipwith Moor in Yorkshire.

18. A red sandy Clay in the right hand Bank of the road beyond Collingham, near the lime-kilns going to——.

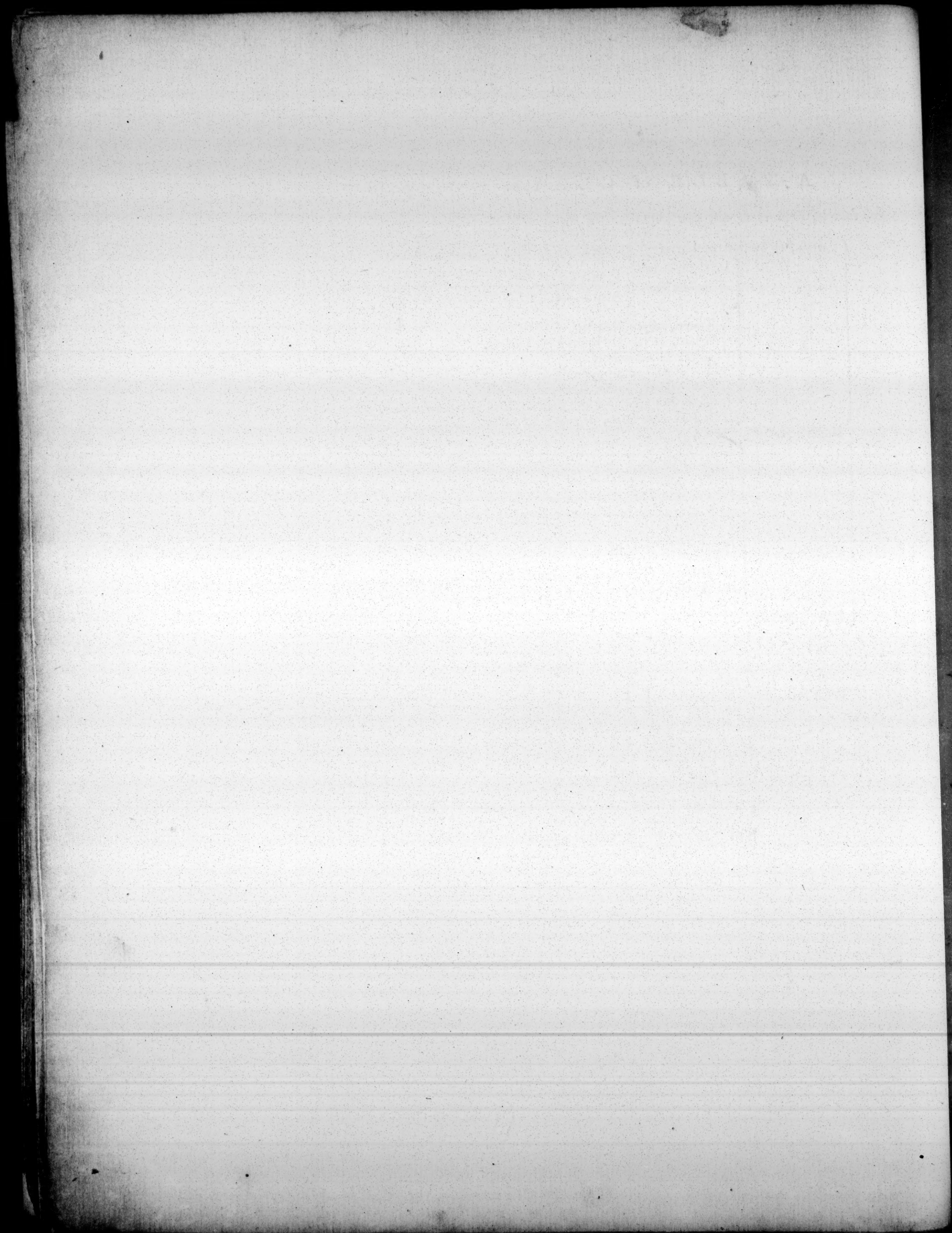
19. A red sandy Clay in the red sand rock near Ripon.

With flat or thin sand, glittering with mica.

20. Crouch white Clay in Derbyshire, of which the glass pots are made at Nottingham.

21. Grey or bluish tobacco-pipe Clay at Halifax.

22. A red Clay in the red sand rock at Rotherham.



such as Birch, Beech, &c. which are not of a constitution to remain long in the ground (as Fir, Oak, Elm, and some other timber will do, and grow the harder) without corruption, and relenting into Mould as soft and tender as what they first were sown or planted in; and of this I am able to give undeniable instances. I insist not here on the perpetual successions and generations of flints and other stones, in the same places where they have been sedulously gathered off, by many (not improbably) thought to proceed from worm-casts, hardened by the air, and a certain lapidescent succus or spirit which it meets with; and this, for happening most on downs very much exposed, (yet undisturbed) is the more probable; as, on the other side, it establishes our conjecture of the purest Moulds being capable of such a change; that which is thus cast up by the worms being so exceedingly elaborated and refined. Nor perhaps are all those innumerable perforations, especially through the hardest surfaces, the labour of worms alone, but the effect of some nitrous spirit that spews out those *moleculæ*. In the mean time, let no man be over confident that because some Earths are soft, fat, and slippery, they may not possibly consist of sands, (of which there are so many kinds) since it is evident that even all fossile bodies, which can be reduced and brought to sands, may, by contrition of the particles, be rendered so minute as to emulate the finest Earths we have enumerated; the compactness and accidental mixtures resulting, as we affirm, from things extrinsecal, not excluding exhalations, passage of liquors, and several juices to them, or conveyed by subterraneous steams and influences, be the stones, or rock, *glareous, metallic, testaceous*, salts, or any other concretes whatsoever. And what if we should indeed suspect all Earth to be arrant salt, nay glass; and that glass, how hard soever, the offspring and child of water, the most fluid, crystalline, sincere, and void of all other qualities? It is not impossible, I think, but by the different texture of its parts, even that liquid element may be brought to the consistence of a most different body to what it appears. We know that water (besides that it was the first immense body which invested the chaos) was by some thought to be the Mother of Earth*, (nay the *principia soluta* of all mixts whatsoever) and

N O T E S.

* This was the opinion of Thales, the Milesian, who taught that all things originated from water. Milton, where he describes the formation of the Earth, makes a beautiful allusion to this doctrine:

On the wat'ry calm
His brooding wings the sp'rit of God outspread,
And vital virtue infus'd, and vital warmth
Throughout the fluid mass.

PARADISE LOST.

that the bottom of the sea was made by a perpetual hypostasis or subsidence, which precipitated from every part of it to the centre. I do not stand to justify these speculations, but to illustrate what I am about, namely, that water is apt enough to be condensed and made hard; and crude mercury, and running metal, crystals, gems, and pearls, do more resemble it than that dirty and opaque body which we usually denominate Earth. Besides, we find how divers waters not only indurate and petrify other substances, but grow into stones, and leave a rocky callus where they drop and continually pass, and that all sands and stones are not diaphanous, therefore that is no eviſtion but that they might once have been fluid, ſince their opacity may be adventitious, and proceed from ſundry accidents; ſo as granting this hypotheſis, we are leſs to wonder that this matter is above all other ſo diſpoſed to vegetation, and apt to produce plants endued with colour, weight, taſte, odour, and with ſundry medical and other virtues, as I think that excellent philoſopher Mr. Boyle, the great ornament of this Society, does ſomewhere make out from the various percolations, concoctions, and circulations of that fruitful menſtrum; and if that be true, that there is but one catholic, homogeneous, fluid matter, (diverſified only by ſhape, ſize, motion, reſoſe, and various texture of the minute particles it conſiſts of, and from which affections of matter, the divers qualities reſult of particular bodies) what may not mixture and an attentive inſpection into the anatomical parts of the vegetable family in time produce, for our compoſing of all ſorts of Moulds and Soils almoſt imaginable, which is the drift of my preſent Diſcourſe? And why might not Solomon by this means have really had all kinds of plants in his incomparable gardens? even ebony, cloves, cinnamon, and from the cedar to the ſhrub, ſuch as grew only in the remotest regions, furniſhed (as he doubtleſs was) with ſo extraordinary an inſight into all natural things and powers for the compoſing of Earths, and aſſigning them their proper mixtures and ferments*. I do not here inquire whether there be not a *panſperme* univerſally diffuſed, individuated, and ſpecified in their ſeveral matrixes and receptacles *pro ratione mixti*, as they

N O T E S.

* It is *climate*, and not *ſoil*, that occasions ſuch a variety in plants; ſo that unleſs we can give a foreign plant ſomething of its *own* climate, it will be in vain to rear it even in its *own* Earth. Of this Monſ. Tournefort, in his Travels into the Eaſt, had very convincing proofs. At the *bottom* of Mount Ararat he found the common plants of Armenia; a little higher up, thoſe of Italy; higher, thoſe which grow about Paris; afterwards, the Swediſh plants; and laſtly, on the top, the alpine plants of Lapland.

ſpeak, but I think there might very unexpected phænomena be brought to light in vegetable productions, did men ſeriously apply themſelves to make ſuch poſſible trials as is in the power of art to effect; and how far ſoils may be diſſembled, and the air and water attempered, (at leaſt for ſome curioſities which may give light to more uſeful things) I do not conclude; but I ſhould expect very rare and conſiderable things from an attentive and diligent endeavour. To this end, the raiſing of artificial dews and miſts, impregnated with ſeveral qualities for the more natural reſreſhment of exotic plants, were, it may be, no hard matter to effect, no more than were the modification of the air abroad, as well as in our more confined Reſerves, where we ſet them in for hyemation, and during the moſt rigorous colds. As for mixtures of Earths; plants we know are nourished by things of like affinity with the conſtitution of the ſoil which produces them, and therefore it is of ſingular importance to be well read in the alphabet of Earths and compoſts; for, as we have ſaid, plants affect the marſh, bog, mountain, valley, ſand, gravel, fat and lean Mould, according to their tempers, and for want of ſkill in this, the ſame plant not only languiſhes and ſtarves, but ſome we find to grow ſo luxuriant as to change their very ſhapes, colours, leaves, roots, and other parts, and to grow almoſt out of knowledge of the moſt ſkilful Phyto-logiſt; not here to ſpeak of what alterations do accrue from tranſplanting and irrigations alone. I mention this to incite the curious to eſſay artificial compoſitions in deſect of natural ſoil; to make new confections of Earths and Moulds for the entertaining of the moſt generous and profitable plants, as well as the moſt curious, eſpecially if, as I hinted, we could ſkill to modify alſo the air about them, and make the remedy as well regional as topical; and why not for other fruits (ſtrangers yet amongſt us) as for oranges, lemons, pomegranats, figs, and other precious trees, which of late are become almoſt endenized amongſt us, and grow every generation more reconcileable to our climate? For, according to Theophraſtus, it is not the exceſſive fatneſs and richneſs of the ſoil which invites theſe exotics and varieties to ſtay with us, or indeed any other plants to proſper, but ſomething which is *connatural* and ſuitable to the ſpecies.

Here we might enlarge upon the ſeveral inquiries formerly ſuggeſted; as, How far principles might be multiplied and differenced by alteration and condenſation? Whether Earth, ſtripped of all heterogeneity and uniform particles, retains only weight and an inſipid ſiccidity? And whether it produces or affords any thing more than embracement to the firſt rudi-

ments of plants, protection to the roots, and stability to the stem; unprolific, as they say, till married to something of a more masculine virtue, which irradiates her womb; but otherwise, nourishing only from what it attracts, without any active or material contribution? It is in the mean time wonderful to consider how such vast, tall, and monstrous trees as Firs, Pines, and other Alpestrals, (whose footing and roots insinuate into the most dry and impenetrable rocks, without any Earth or Mould to nourish them) can grow, exposed as they are to the most rigid colds, fierce winds, and other inclemencies of weather, if the rains, dews, mists, the air, or other visible principle, appear in no proportion to the stature, bulk, and substance of these goodly trees. These indeed, with many other queries, do appositely come in here; but it would perhaps render this Discourse more prolix than useful to enter upon them in detail; nor is it for me to undertake speculations of so abstruse a nature without unpardonable ostentation; and therefore, having only offered something towards the discovery of the great varieties and choice of Earths, (such as we gardeners and rustics for the most part meet with in our grounds) my next endeavour shall be to shew how we may improve the best, and prescribe remedy to the worst, by labour and stirring only; which, being the least artificial, approaches the nearest to nature.

At the first breaking up of your ground, therefore, let there be a pretty deep trench or furrow made throughout, of competent depth, (as the manner is of experienced gardeners) the turf being first pared off and laid by itself, with the first Mould lying under it, and that of the next in succession, that so they may both participate of the air, showers, and influences, to which they are exposed; and this is to be done in severals, as deep as you think fit, that is, so far as you find the Earth well-natured; or you may fling it up in several small mounds or lumps, suffering the frosts and snows of a winter or two (according as the nature of it seems to require) to pass upon them, beginning your work about the commencement of autumn, before the Mould becomes too ponderous and sluggish; though some there are who chuse an earlier season, and open their ground when the sun approaches, not when he retires; but certainly to have the whole winter before us does best temper and prepare it for those impregnating agents.

In separating the Surface-Mould from the deeper, whether you make a trench, or dig holes to plant your trees in, be it for standards, espaliers, or shrubs, the longer you expose it and leave the receptacles open, (were

it for two whole winters) the better it will recompense your expectation ; and especially if, when you come to plant, you dispose of the best and fattest Earth at the bottom, which, if it be of sweet and ventilated mud of ponds, or highway dust, were preferable to all the artificial composts you can devise. In defect of this, (where it cannot be had in quantity) cast in the upper turf, if not already consumed, the sod downwards, with the next adhering Mould for half a foot in thickness ; on this, a layer of well-matured dung ; then as much of the Earth which was last flung out, mixing them very well together. Repeat this process for kinds, mixture, and thickness, till your trenches and holes be filled four or five inches above the level or area of the ground, to which it will quickly subside upon the first refreshings, and a very gentle treading to establish the tree. Fruit planted in such Mould, you will find to prosper infinitely better than where young trees are clapped in at adventure in new broken-up Earth, which is always cold and sluggish, and ill-complexioned ; nor will they require (as else they do) to be supplied every foot with fresh soil, before they be able to put forth lusty and spreading roots ; but which it is impossible to convey to them so as to effect the under parts, by excavating the ground and undermining the trees, after once they arrive to any stature, without much trouble and inconvenience, and the manifest retarding of their progress.

If you will plant in pits and holes, and not give your ground an universal trenching, (which I prefer) make them the larger ; five feet, at the least, square, but not above half a yard or two feet deep, according to the nature of the tree *. In dressing the roots be as sparing as possible of the fibres, small and tender strings, (which are, as it were, the emulgent veins which insure and convey the nourishment to the whole tree) and such of the stronger and more confirmed parts which you trim, cut sloping, so as the wound may best apply to the Earth. The heads or tops I advise you to let alone till after the most penetrating colds be passed, and then about February to take them off, and shape them as you please, as the skilful gardeners can direct you, or as it is described graphically in *Monf. de la*

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* It is certainly the best way to trench the whole land before planting ; but the expence of doing that by the spade, in large undertakings, does generally induce the planter to perform the work by making holes in the manner here *described*, though not *recommended*. Since the days of our excellent Author, the trenching plow has been much improved, and indeed, when properly worked, it is capable of preparing the greatest extent of land for planting at a price infinitely less than the spade.

Quinteny's Complete Gardener *, and his industrious Epitomizers. Now, the Earth in which you thus plant your fruit-trees will require four annual stirrings; namely, at the approach of March, a spade-bit deep, covering it with some mungy stuff, heaps of grass or weeds, to protect it from the parching sun; in May following, after a gentle rain, stir again, but not so deep as to molest the subnascent weeds; again in the month of July; and lastly in October, after the same method you are taught in March.

This, for standards planted out for good and all. The nursery requires a busier process, as it is excellently described by Squire Cotton in that late incomparable *Manual* published by that worthy person. Briefly thus.—Three weeks before Midsummer lay some green fern about the ranks, after the ground is laboured, to defend it from the heats; in which work, care must be also had not to offend the tender roots; therefore you shall stir it deeper in the middle of the lines or interstices; and when winter comes, bury the ferns in the place, by making little trenches, or rather taking away some of the Earth you shouldered up when the stocks were first drawn out of the seminary and planted in those rows; yet so as to leave it somewhat higher than the area, to secure them from the frosts. In March following stir your nursery again, chopping and mincing in the fern, and mingling it with the loosened Mould which you took from the imps when you first applied the fern; then back them up again as before. Repeat this three or four years successively till your stocks are fit to graff on. To an orchard thus planted, spring and autumnal stirring of the Mould is of incredible advantage; and even during the hottest summer months carefully to abate the weeds, (but not to dig above a quarter of a spit deep for fear of exposing them to the sun, unless it be after plentiful showers) is very necessary.

There are, I confess, who fancy that this long exposure of Earth, before it be employed for crop, causes it to exhale and spend the virtue which it should retain; but, provided nothing be suffered to grow on it whilst it lies thus rough and fallow, there is no danger of that, there being in truth no compost or lætation whatsoever comparable to this continual motion, repastination, and turning of the Mould with the spade; the pared-off

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* In the year 1658, Mr. Evelyn published a translation of Mons. de la Quinteny's Complete French Gardener. It has gone through several editions, and is a work of considerable merit.

turf (which is the very fat and efflorescence of the Earth) and even weeds with their vegetable salts, collected into heaps and exposed, when reduced, fall into natural, sweet, and excellent Mould. I say, this is a marvellous advantage, and does in greater measure fertilize the ground alone, without any other addition; for the Earth, which was formerly dull and unactive, or perhaps producing but one kind of plant, will by this culture dispose itself to bring forth variety, as it lies in depths, be it never so profound, cold, and crude, the nature of the plant always following the genius of the soil; but indeed requiring time, according to the depth from whence you fetch it, to purge and prepare itself, and render it fit for conception, evaporating the malignant halituses and impurities of the imprisoned air, laxing the parts, and giving easy deliverance to its offspring.

I do not dispute whether all plants have their primogénial seeds, (as in truth I believe they have) and that nothing emerges spontaneously and at adventure; but, that these would rise freely in all places, if impediments were removed, (of which something has already been spoken) and to shew how pregnant most Earths would become, were these indispositions cured, and that those seminal rudiments, wherever latent, were free to move and exert their virtue, by taking off these chains and weights which fetter and depress them.

It is verily almost a miracle to see how the same land, without any other manure or culture, will bring forth and even luxuriate; and that the bare raking and combing only of a bed of Earth, now one way then another, as to the regions of heaven and polar aspects, shall diversify the annual production, which is a secret worthy to be considered. I am only to caution our labourer as to the present work, that he do not stir the ground in over wet and flabby weather; that the sulcus or trench be made to run from north to south, and that if there be occasion for opening of a fresh piece of Earth for present use, he dig not above one spit deep, which will be sufficient to cover the roots of any plantable fruit, or other tree; he must not disturb it again till the March following, when, if he please, and that the ground seem to require an hastier maturation, there may be a crop of beans, pease, or turnips sown upon it, which will mellow it exceedingly, and destroy the noxious weeds; after which, with a slight repastination, one may plant or sow any thing in it freely, especially roots, which will thrive bravely, and so will trees, provided you plant them not

too deep, but endeavour to make them spread and take in the succulent virtue of the upper Mould; and therefore too deep trenching is not always profitable, unless it be for esculent roots, such as carrots, parsnips, beets, and the like, since trees, especially fruit, should be tempted even by baits to run shallow; such as penetrate deep, commonly spending more in wood and leaves than in the burden for which we plant them.

There is only this caution due, That you never plant your trees where the stiff and churlish ground is likely to touch their roots; for though it be neither necessary nor convenient they should penetrate deep, it is yet of high importance they should dilate and spread, which they will never do in obstinate and inhospitable land (but revert back towards the milder, and better-natured Mould) which crumples the roots, and perverts their posture, to their exceeding damage: And to this infirmity our rare exotic plants and shrubs are most obnoxious, confined as they are to their wooden cases and testaceous prisons, and therefore require to be frequently trimmed, and supplied with fresh and succulent Mould to entertain the fibres, which else you will find to mat in unexplicable intanglements, and adhere to the sides of the vessel, where they dry or corrupt.

Having said thus much of the natural, I should now come to artificial helps, by application of dungs and composts; and indeed, *stude ut magnum sterquilinum habeas*, was old and good advice; but as some there be who affirm any culture of the Earth preferable to dung, even things so slight as the haulm of pease and lupines, or any other pulse, (for when I speak of dungs, I mean those excrementitious and sordid materials which we commonly heap up and lay upon our grounds) I shall beg your patience to suspend a while my stirring that less pleasant mixture, and, till it be well aired and fit for use, proceed on our former subject, and try what aid we may yet expect from more kind and benign means, before we come to the gross and violent. For, besides that such compost (at least so prepared as it ought to be) is not every where, nor always to be had in quantities, to confide in dungs and ordure, is neither so safe, nor of that importance to our husbandman, as some are made to believe; since if we shall look back into the best experience of elder days, (*Hesiod*) we shall find they made very little or no use at all of stercoration*. I know some

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* Mr. Tull, who revived a mode of husbandry antiently practised, was a great enemy to dung, being of opinion that frequent plowing was all that was necessary towards rendering the Earth fertile. By his theory, Earth, minutely pulverized, con-

there be who attribute this neglect to the natural fertility of the country, considering dung as the busy nurse of vermin and nauseous accidents ; but waving these, (without intending to desert the aid of soil in place and time) I proceed with what I call more natural helps ; namely, *opening, stirring, and ventilating* the Earth, and sometimes the contrary, *coverture, shade, rest, and forbearance* for a season, as we daily see it practised in our worn-out and exhausted lay-fields, which enjoy their *sabbaths*. It is certain, that for our gardens of pleasure the fairest beauties of the parterre require rather a fine, quick, friable, and well-wrought Mould, than one rank or richly dunged : And even all fruit-trees affect not to stand upon artificial and loose composts, but in naturally rich and sweet Mould, within the scent and neighbourhood of well-consumed soil for the next layer under, and above, so as the virtue thereof may be derived to it through a colature of natural Earth ; those forcing mixtures being more proper for annuals and exotic plants, which having but little time to live, refuse no assistances, whilst trees of longer duration care not much for accelerations.

I shall here then begin with an experiment I have been taught by a learned person of this illustrious Body (*Dr. Beal*) from whom I have long since received the choicest documents upon this and many curious subjects. And first, I think it will be evinced, as constant and undeniable, that amongst the mechanical aids, (wherein stercoration has no hand) that of pulverizing the Earth by confusion, and breaking it with the plow or

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stitutes the *food* of plants, and under that erroneous influence there is no wonder that he recommended the constant working of the plow and horse-hoe. By this method, commonly called the *New Husbandry*, no change of species is required, as wheat land is continually cropped with that grain, and so of others. The seed is drilled in rows with an interval of four feet, which in summer is continually worked with the horse-hoe. This interval, kept clear of weeds, constitutes a fallow for the succeeding crop ; and in this manner the land annually produces the same grain. However ingenious this method may appear in the closet, it loses its excellence, when reduced to practice in the field, as from the experiments of Sir Digby Legard, of Ganton, in Yorkshire, and even of Mr. Tull himself, the crop does not sufficiently pay the cultivator for his *additional* trouble and expence. And here I wish to be understood as speaking of the drill husbandry with *wide intervals* ; for drilling of grain in *equidistant rows* constitutes quite a different system. My very worthy and excellent friend the Rev. Sir William Anderson, has given the public a very just idea of this last method, for which the reader is desired to consult the *Georgical Essays*, p. 357. Mr. Tull's system has infinite merit, when applied to beans and turnips, which, to the shame of this country, still continue to be cultivated in the old method.

spade, is of admirable effect, to dispose it for the reception of all the natural impregnations we have been discoursing upon. For the Earth, especially if fresh, has a certain magnetism in it, by which it attracts the salt, power or virtue (call it either) which gives it life, and is the reason of all the labour and stir we keep about it, to sustain us; all *dungings*, and other fordid temperings, being but the vicars succedaneous to this improvement, which of all other makes its return of fruit, or whatsoever else it bears, without imparting any of those ill and pernicious qualities which we sensibly discover from forced grounds, and that not only in the plants which they produce, but in the very animals which they feed and nourish.

I know Laurembergius (somewhere) denies this, and that animals in preparing chyle, transmute, alter, and infuse what is only their proper aliment, rejecting all that is superfluous; but as our early asparagus, collyflowers, and divers roots, manifestly refute it, so does the taste of the flesh of fowl, and the milk of cattle that feed on the wild garlick, fenny-grass, and other rank things, not here to insist on their sweet and delicate relish upon change to a more odoriferous pasture. But to the experiment.

Take of the most barren Earth you can find, drained, if you please, of all its nitrous salts, and masculine parts; reduce it to a fine powder, (which may be done even in large proportion, by a rude engine, letting fall a kind of hammer or beetle at the motion of a wheel); let this pulverized Earth, and for the time incessantly agitated, be exposed, for a summer and winter, to the vicissitudes and changes of the seasons, and influences of heaven: By this labour, and rest from vegetation, you will find it will have obtained such a generous and masculine pregnancy, within that period, as to make good your highest expectations: And to this belongs Sir Hugh Platt's contrition, or philosophical grinding of Earth, which upon this exposure alone, without manure of soil, after the like revolution of time, will, as he affirms, be able to receive an exotic plant from the farthest Indies, and cause all vegetables to prosper in the most exalted degree; and, to speak magnificently with that industrious man, to bear their fruit as kindly with us as they do in their natural climates; and this Dr. Munting pretends to have done in Holland. But a little to abate of this, modestly we may say, that this culture (easy and simple as it is) will be found effectually able to render the soil of a most extensive capacity for the entertainment of foreign and uncommon plants. For to enumerate some of its perfections; such as refuse dung and violent appli-

cations, have here pure Earth; and such as require aid, a mellow and rich Mould, impregnated with all the blessings which the influence of the heavens and efflorescence of the Earth can contribute to it, fitted as it is for generation, (and yet so restrained from it) as greedily to receive the first seeds, which are committed to it, with a passion and fervency, as it were, of animal love*. What high and sublime things are spoken more upon this, I forbear to prosecute; but in Sir Kenelm Digby's Discourse of Sympathetic Powder, he affirms, that the Earth, in the years of repose, recovers its vigour by the attraction of the vital spirits which it receives from the air and those superior irradiations which endow simple Earth with qualities promoting fermentation. And indeed, such a vegetative activity I have often observed in the bare exposure of some plants but for a few hours only, as has raised my admiration, particularly in the aloe and other kinds of sedums, which, when to all appearance shrunk and shrivelled up, have filled themselves in a moment, set out in the air, when a very few drops of water (at the time, that is, winter time) would certainly have made it rot and turn to a mucilage, as to my cost I have experienced. And these ferments of the Earth, by this amity and genial intercourse with the air, are innumerable, to concoct, digest, accelerate, and restore; equal to, yea, beyond any artificial enforcements of dungs and composts whatsoever†. But to return to dust again. By the toil we have mentioned, it is found that soil may be so strangely altered from its former nature as to render the harsh and most uncivil clay obsequious to the husbandman, and to bring forth roots and plants, which otherwise require the lightest and hollowest Moulds.

In other cases and affections, the Earth may be likewise fertilized, as from without, so from within, by more recondite and central causes and agitations, which if in excess, may be allayed with some feminine or other

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- * Virgil supposes the Earth to be in this state, when he says,
Vere tument Terræ et genitalia semina pascunt.

† From accurate experiments made by Dr. Stephen Hales and others, it is certain that the leaves of plants draw from the air a considerable portion of aqueous fluid, in which a large share of nutriment is minutely dissolved. This nutriment is certainly produced by putrid steams, generated upon the surface of the Earth, which, flying upwards, become blended and incorporated with the atmosphere. Showers of rain bring down these particles again to the Earth, and probably they are delivered to the mouths of the vegetable creation in a more elaborated state, in consequence of their solution in the atmospheric vapours.

mixture; since oftentimes qualities too intense rather poison dry and choleric grounds, than conduce to their advantage, as we shall come to shew; and that which makes a cold and moist ground fertile, will destroy the contrary, as we see in the too free applications of salt; and therefore it requires no ordinary dexterity to be able to direct where and what remedies are to be administered, since we find it the same in vegetable productions as in the animal, where complexions should be suited; for want of which care, through avarice and other sordid circumstances, Noble Families themselves are many times rendered childless, which might else have multiplied and been perpetuated. To illustrate this by our present subject; we find, that a thin sifting, or sprinkling of ashes, has enriched all the higher pastures, when, where strewed too thick, the ground became totally barren. Sometimes, again, defect of sufficient depth may be the cause of sterility; and so it frequently happens, that the proper remedy of some hungry and shallow surface, is to superinduce and lay more Earth upon it, and to find out the medium, by diligent trials of some degrees of depths in the same soil; but solitary, single, or over hasty experiments, before the Earth be prepared by some of our fore-mentioned essays, may prove discouraging and insufficient, as my Lord Bacon has oft advertised us.

Earth is also sometimes improved by mixtures of fern, rotten leaves, and the pouriture of old wood, the haulm of beans, pease, and other legumina, which heat and accelerate concoction; for which, and all other medications, the nature of the Mould is carefully to be examined, that application be made accordingly; as for instance, if it be sandy, or other light mixed Earth, to imbody it with something of a fatter nature, as lime or marl, (for I yet forbear the touch of ordure or animal composts, as the least natural) and be sure so to stir and lay it (especially if lime) that it may not sink too deep and suddenly as it is apt to do, and so desert the Surface-Mould, where it should do the feat, and therefore it is to be the oftener renewed. But marl enters as properly here, and so does mud, slub of slimy waters, especially if the soil be gravelly and mixt, which it will fadden and impinguate, and consequently bind; but if the gravel be wet and cold, lime is preferable: Wherefore the nature of the Mould should be well examined before the application: as here arenous and sandy Earth wants ligature, and besides, consisting of sharp and asperous angles, wounds and galls, curls and dwarfs our plants, without extraordinary help to render the passages more slippery and easy; therefore relenting chalks, or chalk-marl, is also profitable, with calcinations of turf, or sea-wreck, where it is at hand; and if the soil be exceed-

ing bibulous, spread a layer or couch of loam, discreetly mingled at the bottom, to entertain the moisture. In the mean-time, there are yet some plants which thrive almost in nothing so well as in sand alone, or with very little mixture, nor that of any dung: So melons are said to grow in Jamaica, and some vast timber-trees have little or no mould adhering to their roots; such is that beautiful stranger the Japan Lilly, called by those of Guernsey (from whence we only have them) *La Belle de nuit*; and a certain palm of the same Japan, which shrinks and dries at the least touch of water, as if it were laid before the fire, which is, it seems, the only remedy that restores it, or the sudden replanting it in scales of iron, or the most burning sand. But what if sand itself, however vulgarly reputed, be not so hot or interiorly ardent as it is given out to be? Indeed, for being of an open and loose contexture, it is apt to put forth a forward spring, as more easily admitting the solar rays; but it does not continue, and is an infirmity which may be remedied with loam, which not only unites it closer for the present, but is capable in time to alter and change its very nature also, so as too hot a compost be no ingredient with it*.

Here I take notice, that husbandmen observe a too clean and accurate gathering of stones from off those grounds which lie almost covered with them, rather impoverishes than improves the land, especially where corn is sown, by exposing it to heat and cold. Certain it is, that where the

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* Light sandy soils are best improved by marl, but as that most excellent Earth cannot be procured every where, some judicious persons recommend clay, which, from various trials, is found to answer very well upon light lands. In proportion to the lightness of the soil, the quantity of clay must be increased or diminished. The best and most profitable method of applying clay to sand land, is thus described in the *Georgical Essays*:—"Where the land has never been broke up, the clay may be carried and spread, and suffered to lie a whole year before it is plowed in. The swarth will fet the clay a-working; but, where there is no swarth, a coat of dung will be necessary before the land is sown. Where the clay is short, and the soil light, 120 loads will be required for an acre; but where the clay is strong, and the land not so light, then 60 or 80 loads will be sufficient. It is better to lay on too little than too much; it will be sufficient if the land is made moderately cloddy. About a cubical yard of clay makes a load. Carry the clay at any convenient time of the year. If time permit, carry it after harvest, and lay it upon a wheat stubble; there let it remain spread all the winter. In March plow it in; plow again in May; and twice in June; and sow turnips about Midsummer. In Norfolk, they formerly paid one guinea for filling and spreading 120 loads of clay, but now (1772) they are obliged to allow something more." p. 424.

stones are not too gross and plentiful, a moderate interperision of the smaller gravel preserves the Earth both warm and loose, and keeps it from too sudden exhalation; whilst the over-fine grain, or too nice a sifting, makes it apt to constipate and grow stiff upon wetting, so as the tender seedlings can hardly issue through; and this is a document for ignorant gardeners, who, when they have a fine flower, think they can never make the ground fine enough about it; yet the finer the plant or seed, the finer should the Mould be which entertains it; though, when all is done, trees thrive best where they have easier footing.

Chalky grounds come next to be considered, and they should be treated like gravel, sand, and stony, if harsh; but if of the melting kind, it is apt to mix with all the sorts of Moulds; and being of itself so husbanded, composes a kind of natural soil fit for most uses sought for, and of admirable effect in dry grounds.

Here now of course we are to say something concerning calcinations, all reducing of stone into ashes being of excellent use where lime is upon any occasion proper; and indeed all our composts and dungings serve but to this end, namely, so to qualify and mix the soil as may artificially answer to the varieties of the natural Earth, or such a constitution of it as the skilful husbandman requires: As for instance, (since all fertility is the result of mixture contrary in quality) if it want due heat, to apply additions of a fiery nature; and therefore it were profitable, if in the using lime with turf and swarth it were laid alternatively, turf on lime, and lime on turf, in heaps for six months, by which means it will become so mellow (and rich in nitrous salts) as to dissolve and run like ashes, and carry a much more cherishing vigor than if amassed in greater quantity; and so, by a too violent application, burn out and exhaust the vegetative virtue which it should preserve. There is, (by the way) this caution to be used in burning of Earth, that though what is torrifed into blackness will exceedingly fructify; yet if it proceed to adustion beyond that degree, it consumes the nitre, which is the principle that should be preserved, as we shall come to shew when we speak of salts, which we are the most carefully to keep entire in all our animal or other composts*. If once the nitrous

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* Turf reduced to ashes by a vehement and open fire forms a hard substance called *glafs*; so that burn-baking, under such circumstances, can do no service, the vegetative powers being changed into a body incapable of the least solution in any menstruum. A moderate and confined heat, on the contrary, reduces the vegetable substances contained in the turf, to an alkaline salt, well known to be a great promoter of vegetation.

spirit be quite mortified, the Earth produces nothing, until being long exposed it have attracted a fresh supply to give it life, and prepare it for conception: For, otherwise, all moderate burnings, yea and even sometimes (to appearance) immoderate (as that of rose-trees, reeds, and some other, which makes them bear and come the better) is excellent manure, as we see it in straw and stubble, enriched as they are with salts; and if the very Earth be roasted with the fire, it solves obstructions, laxes the pores, renders them attractive of the heavenly influences, and cherishes with its warmth. The more simple and unmixed the ashes be, in relation to what the ground produces, it is the better; for as weeds bring weeds, so the ashes of fruits and berries (being burnt) dispose to bring forth the same; nay, Honoratus Faber affirms, that wheat burnt to ashes produces wheat; so as no treatment of the seminal rudiments ever seems totally of power to annihilate their virtue, so strict is the union of the parts from whence their forms result*. The calcination then of Earth alone not only disposes it to produce great variety, but if it be intense, increases the very weight of the Mould; whether from a certain magnetism which it thereby contracts, (which fortifies it to draw the proper aliment more powerfully) or upon what other account, let the curious examine. In the mean-time, whilst we are on this of burning the Earth, and that many think the fixed salts to be the same in all vegetables, (and their great virtue included in this volatile, totally lost by calcination) the powder of plants is by some thought preferable to the ashes; which husbandry, (after the Romans had long since used, even in Britain, for near five hundred years, but discontinued by their expulsion and depopulation) was revived again in Flanders; from thence it was brought into Devonshire, and about sixty years after cultivated more generally. It had great success at first, (especially on chalky and barren grounds) but sensibly diminishing, occasioned the proverb that, *What is good for the father, is sometimes naught for the son*; however, the fertility is again restored, by feeding sheep upon the ground; a dressing of all others the most desirable.

Two loads of turf will make a load of ashes, which, spread on sterile lands, spontaneously produce the Cinqufoil†. Lime, a little flecked, is

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* This is very unphilosophical, and contrary to experiment.

† My very worthy friend, General St. Leger, has communicated to me the following experiment, which with great exactness ascertains the quantity of ashes to be

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excellent for cold, wet grounds, and stiff clays, but over-burns the drier. It is the very best destroyer of moss and rushes, as quick lime does furzes, being first extirpated.

I come next to marl, (amongst other parts of agriculture introduced by the same Romans) of excellent use to fix light sand and dry grounds; some commend the white and gray, and others the blue and red, (which I think the best) according as it is more or less apt to resolve after wetting; but none of them discover their virtues for the first year: It does incomparably on pastures; some on arable, a good coat of compost suitable to the land being first spread where you will lay it: If your marl be very unctuous and rich, apply it less copiously; the too thick covering is the worst extreme, nor is it always to be used without allay and mixture with other proper soil; for some marls are more sandy and gritty than others, and should be qualified with a contrary. Give lean and emaciated Earth a covering of the fattest marl; apply hot and dry to the cold and moist: and this is also to be observed in the application of all other composts and medications*.

Marsh and churlish Earth will be civilized by the rigor and discipline of two winters; *bis frigora*, is the old method to make the stubborn clod relent; and, with the mixture of a little sand, if it be too close of body, it will become excellent Mould.

Clay is, of all other, a curst step-dame to almost all vegetation, as having few or no meatus's for the percolation of the alimetal showers, or expansion of the roots; whether it be the voracious, hungry, weeping, or cold sort. In these cases, laxatives are to be prescribed, such as drift sand, finely gritty gravel, saw-dust, with marl or chalk, and continually vexing

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obtained from an acre of land by burn-baking. "In August, 1772, I pared and burnt one acre three roods of lime-stone land, and carefully collected the ashes into two heaps for a future experiment. Having so good an opportunity, I measured the ashes, and was much surprized at the quantity, being eighty cart loads, thirty bushels to the load,." *Georgical Essays*, p. 382.

* When Marl can be procured, we need not be scrupulously nice either in its kind or application; for, as far as I can learn, it never disappoints the expectations of the farmer who has spirit and industry to use it. It invariably loosens a stiff soil, and gives texture to a loose one; a circumstance of the utmost importance to the tillage farmer, and indeed all that is necessary for *him* to know concerning the nature of this Earth.

it with the spade or plough; but, above all, with sea-sand, where it may be procured, and the burning of the ground to ashes, with all that it bears, the more the better; for by no less severity will this ill-natured Mould be subdued. Rotten wood, and the bottom of havine-stacks, is a good ingredient to this manure; and, if the land be of a cold and wet quality, strewings of soot is good; if very stiff, rubbish of brick, lime-stone, and such trash, may properly be laid at the bottom, and, on the upper part, composts of dung; for otherwise no limings (which being flecked is raw and cold) may at any hand be applied, especially to the hungry sort, which (as also most kinds of Marsh-Earth) is subject to chasm, and gape in dry seasons; to prevent which, a *discreet* mixture of ashes and sand is used; for, if it be in excess, it over-heats the latter.

I do not reckon loams among the clays, though it seem to be but a fuculent kind of argilla, imparting a natural ligament to the Earth where you mix it, especially the more friable, and is therefore, of all other, the most excellent mean between extremes, fastening and uniting that which is too loose or stony, cooling that which is hot, and gently entertaining the moisture. The flower garden cannot be without a mixture of it, nor well any fruit, especially the best cider-apples, so it be accompanied with a lighter soil.

To sum up all we have said concerning Natural improvements, by mixtures of Earth with Earth, rather than dungs, let us hear my Lord Bacon: He reckons up marl, chalk, sea-sand, Mould upon Mould, Pond-Earth with chalk, and the several blendings and tempering of them; among all which, we find Marl to carry the pre-eminence with his Lordship, as the most pinguid, rich, and least over-heating; next to this, Sand, as the most abounding in salt; Chalk, more heating, and therefore proper for clay, cold, and spewing grounds, being suffered to lie a competent time to resolve before you turn it in; Earth on Earth, that is (I suppose he means) the under part upon the upper, or the second spit on the first, as we have all along directed at the breaking up of fresh ground with the spade.

Another mixture he commends (and on which we have likewise newly touched) of substances, which are not mere Earth, as soot, ashes, not the hard and dry cinders of sea-coal, (which we are too busy with in places

where the ground is naturally too hot and dry) but such as is apt to relent; and even the sprinkling of salt, where it is wisely sown.

A third is the permitting vegetables, abounding in fixed salts, to die into the ground, as pease-haulm, bracks, and all sorts of stubble cast on about the beginning of winter: So leaves of trees mingled with chalk, and proper composts of dungs, to heat and preserve the ground from souring with them when they are used alone*.

A fourth is (on which we have also touched) heat and comfort, procured by calcinations, the burning of ling, heath, sedge; covering the ground with bushes for a time; inclosures of walls and mounds, when the land lies in the eye of the weather; and in other cases, meridian exposures, and the warmth of the woolly fleeces of sheep as well as manure, folded or pastured: And to this we may add the very grazing of cattle, which in some cases has succeeded better than the best dungy compost, especially for old and decayed orchards, which have been observed to recover to admiration when mowing has been pernicious; for even the biting of cattle gives a gentle loosening to the roots of the herbage, and makes it to grow fine and sweet, and their very breath and treading, as well as soil, and the comfort of their warm bodies, is wholesome, and marvellously cherishing: But this is to be understood of places where the trees are of full growth, and where the beast cannot reach to crop†.

Lastly, Irrigation and Watering, both by admitting and excluding moisture at pleasure: And certainly this has (since his Lordship's time) been found one of the richest improvements that ever was put in practice, especially where they have the command of fat and impregnate waters, without grittiness, or being over harsh and cold; whether it percolate through rich ground, or, which is better, descend from eminences and

N O T E S.

* The leaves of some trees sooner become Mould than others. The leaves of Oak, Birch, Spanish Chestnut, and Oriental Plane, are with great difficulty converted into vegetable Earth, even when put into the fold-yard, and trodden with cattle.

† Nice farmers consider the lying of a beast upon the ground, for one night only, as a sufficient tilth for the year. The breath of graminivorous animals does certainly enrich the roots of grass; a circumstance worthy of the attention of the philosophical farmer.

moderate declivities, from whence we find the valleys so luxurious and flourishing*.

To this belongs the cure of wet and boggy lands, by cutting trenches deeper than the cause of the evil, which proceeds from concealed springs hindered from emerging forth by the sluggish incumbent Earth. This makes the ground to heave and swell, but, not giving vent, it stagnates and corrupts both the water and the Mould about it; and though it lie loose and hollow, yet it gathers no vigor from above, but remains cold and insipid. The remedy is opening the ground till you meet with a found bottom, and cutting your furrow upwards to the bog, about a foot beneath the spewing water: This is to be done in several places, and when the drains appear to have wrought the effect, you may fill them up again with spray and bazine, great and rough flints, brick-bats, tiles, shards, horse-bones, the skulls of the slaughter-house, or any other rubbish which will remain loose and hollow; cover them with the grassy side of the turf which you pared off and laid apart, and on that throw your other Mould, which, being cast up in heaps for some time, will be much improved with spreading; lastly, sow it over with hay seeds.

But the cure is yet easier, if the land lie considerably sloping, and if it happen to be a planted ground, then cut your trench deeper than the roots of your trees, and apply the foresaid rubbish to intercept the moisture. About the latter end of October, trench the ground all over for near a foot and a half in depth, and when you are come within three

N O T E S.

* The advantages of water meadows are little known in the northern parts of this kingdom, and it were to be wished that some ingenious person would favour the public with a good account of the manner of constructing them, together with their uses. It is of the utmost importance for the farmer to have early grass for his ewes and lambs, and no method hitherto known (water meadows excepted) does effectually provide him with it. It is not necessary that the water employed should come from a river, or be loaded with earthy particles, as pure spring water when drawn over the surface of grass grounds during winter, and kept continually gliding, is found of equal use. I have often remarked upon heath lands, where springs frequently break out, that the Earth which receives the water is full of verdure at an early season; and at the same time I have observed that the heath was effectually killed in all places over which the water had spread. From this we may conclude, where circumstances will allow, that drawing water from the high springs, over dry and barren heaths, will bring them sooner into cultivation than the expensive methods now practised of paring and burning the surface, as preparatory to the plow.

or four feet of the stem, cut off all the larger roots sloping inwards, sparing only the fibres, and such of them as you find tender, and about as big as your finger; leaving also the more perpendicular to keep the tree steady. This done, cast in some rubbish of brick-bats, lime-stone, (not chalk) and other materials, that the Mould may lie easy about them, and with a mixture of good Earth, plenty of rotten stubble or other soil, apply it near the root, and fill your trench with the rest; and if your ground require it, (as being too cold it commonly does) add to your compost the dung of sheep, pigeons or poultry, very well consumed; and because moss is oftener caused by starving and wet grounds, than by hot and over dry, (for both produce it) the cure is likewise to be effected by ablation, and baring the roots as above; and for the latter, by a mixture of loam, with the scouring of pond or ditch Earth, which of itself is the most excellent manure, and the planting your trees at greater intervals, for admission of air and sun; since the scraping of it off, which may also be done in wet weather, is but temporary, and if nothing else be performed, it will be sure to grow again. And here upon observation how men *carbonade* and cut so many rills, and narrow trenches irregularly crossing one another, to drain their meadows and lower grounds, which take not up a little part of the turf, I should rather recommend the cutting of a large trench through the whole length of the pan and bottom of the ground, and of competent depth to receive and drain the weeping springs, instead of those frequent flashes and gutters I have mentioned; since besides the beauty of the canal, the profit of the fish, &c. the Earth and mud cast out on both sides, and spread upon the depressed and lower parts of the ground, will not only raise the unprofitable marsh, but thereby improve it for pasture. One needs go no farther to see the effects of this husbandry, than to St. James's Park, where, before the canal, I remember all that pleasant valley, now yielding most rich pasturage, (with the fish, decoy, and walks planted with fragrant lime-trees) was nothing but a noisome, unwholesome bog and morass of moss and rushes. The use of the plow is for this work the most expeditious, and cheaper than the spade alone, which, after every journey of the first, will be necessary to cast and shovel out the loosened Earth on both sides, to fill up the hollows and depressures of the ground, and with the rake to trim the banks and level the rest as is requisite. This, undertaken in dry summer weather, the plow still succeeding the spade till the channel be of convenient depth, will of all other be the most effectual; and, if near the mansion-house, a graceful addition to it. But to return to other remedies.

Lands which are cold and dry, are (as we have hinted) to be improved by contraries; namely, by application of composts which are hot and moist; as sheeps-dung, burning and calcining of the Earth with the vegetables on it, and the like, to excite heat and fermentation; but which is not to be effected without repugnant remedies, and such as are of heterogeneous parts, to stir and lift up the Mould, and render it less inactive. If it be cold and clinging, as frequently it is found, there, lime-rubbish, the small harther chalk, sea-coal ashes, a moderate sprinkling of sand, with some compost, may perform the cure*.

Hungry grounds require to have the cause well looked into, (the water turned as above directed) or if it want, such as is well enriched.

Lands that are hot and burning, allay with swine's dung as (some say) the coldest; or with neat's, which will certainly refresh it.

For Earth which is too light, there is nothing better than pond-mud, after a winter has passed over it.

Earth over rank (for there be some too fat as well as too lean) sand and ashes will take down, but still have regard to what you design to plant upon it. Neither the almond nor the haseel will endure a wanton Mould; and though it seem a paradox that any soil should be too rich, (upon which some critics have suspected the text in Theophrastus, which asserts it twice in two successive chapters) it is yet a truth indubitable, and holds as well in plants as animals, which growing very fat, are seldom prolific. Some lands on the contrary are so lean, dry, and insipid, as hardly any pains will make them fruitful. Such are mineral and metallic soils, devouring clays, light and ashy sands; some again are putrid and fungous; others, though fruitful, producing only venomous plants, hemlock and the deadly aconite, and some, though wholesome ground, may be poisoned with unskilful or malicious mixtures, and with damps and arsenical vapours, which sometimes (though natural) are yet but accidental and for a season, as when after extraordinary droughts and stagnant air the Earth hath not been seasonably opened, refreshed, and ventilated.

N O T E S.

* Some lands are wet and poachy in winter from a bed of clay keeping up the water that falls from the heavens. The best method of rendering such lands firm and dry, is described in the *Georgical Essays*, p. 437, by my excellent and learned friend, T. B. Bayley, Esq; whose activity and diligence in the public service merit the highest praises.

Moreover, ground is sometimes barren and becomes unfruitful, by the vicinity of plants, sucking and detracting the juice of the Earth from one another. Thus we see the reed and fern will not be made to dwell together; hemlock and rue are said to be inimical; the almond and the palm are seldom fruitful but in conjunction; and perhaps there are effluvia, or certain inconspicuous steams of dusty seeds, which not only impregnate places where never grew any before, but issue likewise from one to another, as I observe in our junipers and cypresses flowering about April, which are trees of consort, and thrive not well alone. The ficus never keeps her fruit so well as when planted with the caprific *. By what irradiations the myrtle thrives so with the fig, or why the vine affects the elm, and olive, (which is at antipathy with the Oak, and imparts also such a bitterness to the Mould, as kills lettuce and other subnascent plants) and why some affect to live in crouds, others in solitude, is hard, to say; but that Firs, Pines, Cedars, Elms, and divers other trees, aspire and grow so tall in society, may be (as from other causes) so from their not overglutting themselves with nourishment (for compost is not their delight) which inclines them rather to shoot upwards than expand and spread.

Lastly, Ground is rendered barren by *shade*, and the dripping of umbrageous trees. To these air and sun may be soon restored, by removing the skreens which intercept them; and yet all shade is not unpropitious where the soil and climate are benign, as well as that which casts the umbrage; and of this we have a notable instance somewhere amongst the *Astomi*, and even in Africa, where the Soil and air are so genial, that the Olive is said to grow under the Date-tree, the Fig under the Olive, under the Fig-tree the Granade, under that the Vine, under the Vine a crop of corn, and at the feet of the corn a certain pulse; none of them impeded by the more than *reduplicated* shades. But there are some, we must confess, amongst us, which are not so propitious; trees of all sorts (though the perennial greens least) breathe as much after the air as the soil, and do not thrive without it, nor except it be wholesome.

But to return to barren Earths, which are either out of heart by being spent, or from the nature of the soil (in both which cases the plants pro-

N O T E S.

* Tournefort, during his abode in the islands of the Archipelago, had an opportunity of observing this curious fact. For his account of it, consult the notes on the *Silva*, p. 449.

duced, though never so unprosperous, run hastily to seed, or make an offer) they are to be restored by the plough, the spade, and the rake; by stirring and repose, appositions and mixtures of Earth, calcinations, and composts; and above all, by *the eye of the master, and dust of his feet*, as the Italian proverb has it. For after this process, and innumerable other trials, (mixtures of things being endless) all other sorts of Earths and imperfect Moulds may be treated and meliorated; namely, if it be too hard and close, mollify and relax it; if too loose, give it ligature and binding; if too light, ballast; if too meagre, fasten and impinguate it; if too rich and luxurious, emaciate and bring it down; if too moist, apply exsiccatives; if too cold, fermenting composts; if excessive hot, cool and refresh it; and thus Earths should be married together like male and female, as if they had sexes; for being of so many several complexions, they should be well considered and matched accordingly, things (as was said) becoming fruitful from the mixture of repugnant qualities; so as cold and dryness, without a warm and cherishing moisture, produces nothing. For this therefore you see what choice I have presented you of sand, ashes, chalk, lime, marl, mixture of Mould, calcinations, air, sun, dew, rain, frosts and snows, trenching, drilling, watering, infusions, and finally, of animal stercorations and other composts, which is the next and last part of this (I fear) over-tedious discourse; since indeed it is not sufficient to find out even the best and most grateful Mould in nature, so as to rely for ever upon the same performance, without supplies of all sorts, stirring and repose, constant dressing, and (after all we have said) artificial lætations likewise, to encourage and maintain it in vigor.

We proceed then in the next place to what farther advancement we may expect from stercoration, and manuring the ground by composts, and to discover the qualities which may be latent in their several ferments, and how to apply them by a skilful and philosophical hand, without which they do always more hurt than good; and therefore, first, we will enumerate their several kinds; we shall next enquire what it is we chiefly seek for and expect from them; and lastly, shew how to treat them so as to render them fitting for our service.

From animals, we have the soil of horses and other beasts of burden, neats, sheep, goats, hogs, pigeons, poultry, and fenny fowl. We have also flesh, fat, blood, hair, feathers, urine, shavings of horn, hoofs, leather, skins, fish, garbage, snail-mud, &c. From vegetables, (as of

nearest affinity) we have vine-cuttings, stalks, fallen leaves, marc of the wine and cyder presses, lees of wine, oil, rotten fruit, gourds, weeds, fern, haulm, stubble, rotten wood, saw-dust, refuse of the tan-pit, seaweed and old rags; also brine, pickle, ashes, soot; and of things promiscuous, washing of dishes and barrels, soap-suds, slime, and scouring of ponds and highways, dust, sweepings; in sum, whatsoever is apt to rot and consume in any competent time, and is either salt, unctuous, or fatty; to which let me add impregnating rains and dews, cold and dry winters, with store of snow, which I reckon equal to the richest manures, impregnated as they are with celestial nitre. But with all these auxiliaries, we are not yet to imagine that any of them are therefore profitable and good, because they retain an heady scent, are hot, moist, rotten and slippery, fat or unctuous, and the like, which are all qualities that alone, and of themselves, effect little till they are corrected and prepared; but, for that among these materials we detect the causes of fertility more eminently than in other substances, partly from their fixed salts, or some virtue contained in them, or rather drawn from without, and imparted to the exhausted and defective Earth; and that by such a process, as by converting them into a chyle, (as it were) it facilitates their being infused, assimilated, and made apt to pass into nourishment, promoting vegetation. This obtained, the next thing is, skilfully to apply what we have prepared; and this indeed is a difficulty worthy the heads, as well as hands, of the profoundest philosophers, since it requires a more than superficial knowledge and penetration into causes.

We know, indeed, that the Earth is, without any artificial auxiliaries, endued with a wonderful prolific virtue; but this, for being possible to decay and be lost, (at least for a longer time than our necessities can support) and from some grounds never to be expected without such helps, it may be worth our while a little to consider by what expedients of digestion, or other ways, the desired effect of perpetuating its vigor might best be accomplished.

That the secret we inquire after, and which does most apparently seem to evirtuate towards this end, is some vegetable salt or matter, I suppose is generally agreed; for salt it is which gives ligature, weight, and constitution to things, and is the most manifest substance in all artificial compounds.

It is salts which entice roots to affect the upper and saline surface of the Earth, upon which the nitrous rains and dews descend; and the cause that some plants, the most racy, and charged with juice of all other, (for such is the vine) thrive so well amongst rocks and pumices, and in whatever best maintains this vital pickle.

It is salt which makes all covered and long shaded Earths to abound in fertility, and renders the dung of pigeons, poultry, and other salacious corn-fed birds, so eminently effectual before the soil of horses and other beasts, in which it less abounds, as having less virtue to attract it *.

It is salt that gives such vigor to places sprinkled with urine, soot, ashes, &c. which have them not diluted; and to bones, flesh, horn, hair, feathers, blood, and the rest of those animal excrements: And whence those seminal masses should proceed after calcination of the Earth, when it comes to be exposed again, is hard to divine; whence, I say, they should derive their life and energy, without being destroyed by so powerful an agent as fire, unless they lurk in some vegetant and indissoluble salts, (volatile, fixed, or nitrous Earth) from whence they (Phoenix-like) emerge, though I do not say without any other specific rudiment: But it is strange, what, as I remember Dr. Morrison affirms of the *Erysimum*, or *Iris*, so seldom seen to grow spontaneously in England before the late prodigious conflagration of this City, when there appeared more of it amongst the ruins than was known to grow in all Europe besides; it being a curious exotic, to be found most about Naples in the time of Fabius Columna, and but rarely elsewhere †.

N O T E S.

* The richness of poultry and pigeon dung appears rather to arise from its being overcharged with oil and mucilage than any thing saline. For further information upon this subject, consult the note upon the 27th page of the *Silva*.

† This is the *Sisymbrium (Iris) foliis runcinatis dentatis nudis, caule lævi, siliquis erectis*. Lin. Two years ago a crop of wild mustard (*Erysimum vulgare*. Bauh.) was reaped from the banks raised at Hull to form a dock for the reception of shipping; and it is generally observed that a spontaneous crop of this vegetable makes its appearance, for two successive years, upon the banks of all large drains made in Holderness. Similar appearances have been observed in the isle of Axholme and other low countries. This phenomenon proves that seeds, when kept from air, may retain their vegetative power many years beyond the term seemingly allotted them.

It is salt which refuscitates the dead and mortified Earth, when, languishing and spent by indulgence to her verdant offspring, her vigor seems to be quite exhausted, as appears by the rains and showers which gently melt into her bosom what we apply to it, and for which cause all our composts are so studiously made of substances which most ingender or attract it.

It is salt which fertilizes and renders Egypt so luxuriously fruitful after the inundations of the Nile; and the nitrous grounds of Jamaica, and other places, cause a stupendous growth of plants and trees.

It is the want of salt which emasculates the virtue of seeds too long macerated in hungry water, and renders floated wood such unprofitable fuel, and to turn into such insipid ashes; and whatsoever it be some plants may appear to affect, as to the external differences of appetite, some of them seeming to draw in more air, some Earth, and others water in extraordinary measure, according to the several contextures of their parts, or by whatever magnetisms and attractives, it is still to come at their salts, which doubtless create that inclination, and compose the various saps and juices which they present us. Nay, what if I should say that all the several parts of vegetables were endowed with their peculiar and distinct salts, through different motions, complications, and percolations? Or, that so many Earths, so many kinds of salts digested and transported by their different vehicles and strainers; and those also, though unlike in quality, yet perfectly congruous to what they produce and nourish? But, what this vehicle or menstruum is, I contend not. It is evident that salts unite best with water, vernal and autumnal showers and dews, as the most apt to convey their insinuations. You know, who have dignified salt with the prerogative of being named Element-Earth, the vigor and close of all things; yea, the first and last of elementated bodies. What shall I say, *Quid Divinum!* the original of all fecundity; nor can I say less, since there was nor sacrifice, nor discourse, acceptable without it. And verily, upon serious contemplation of the premises, and the little experience I have had of their effects in this work of vegetation, as far as I am able to penetrate into causes by them, I am not displeased at the magnificent epithets which are given it. In the mean-time, I know there be who are so averse to this doctrine, as to prefer water alone before it; nor contend I with them, so they allow the near affinity and friendship which is between them, as I have deduced it at the entry of this Discourse, where I describe my Autoptical Observations of the several Earths: all

that I pretend from hence being only to excite us to make diligent enquiry what may more likely be the cause of vegetation, and whether salt have not a dominion almost monarchial in this great work of Nature, being so absolute an ingredient in all our dungs and composts. I cannot in the mean-time but wonder how a thing so eminently sacred and fertile, should come to be the symbol of malediction, when, as the custom was, they used to sow salt in the place of Cities they had erased and cursed, there being in all nature nothing so pregnant and fruitful; unless it were to invite the plow to go there, and that the fertility of the spot for corn and grain might divert them from rebuilding and covering it again with houses. Indeed, to apply salt in excess, burns the Earth for a time, so as nothing will grow upon it; but, when once the rains have well diluted it, vegetables spring up more wantonly than ever. This I daily find by sifting common salt upon the gravel-walks of my garden, and for which cause I have left it off; and we find that the Earth itself over-marled, and too highly manured, is as unprofitable as if it were barren for the time, and that there is in all things a just proportion to be observed.

But neither all this while do I pretend, much less determine, that the principle I so much celebrate, is our common artificial salt, composed of urine, and the like, which of itself is so burning and destructive till its acidity be qualified by the air and showers from heaven, (which endows it with a natural magnetism to receive their irradiant virtues) but a certain more unctuous spirit, or airy nitre, pregnant with a vital balm, which is the thing we endeavour to find in the materials of composts; but whether it be accidental or essential, corporeal or more spiritual, principal or organical, or (to speak with the Chymists and later Atomists) whether communicated by effluvia, salts embryonate, or undigested and not specificate, from ferments, spermatic vapours, influences celestial, or from liquor only impregnated and concocted, I leave to those who affect to wrap up *easy* notions in *hard* and uncertain terms, whilst the things would be of use to the philosophical husbandman, were they reduced into just classes, for the better discriminating of the several composts; as which of them most abound in nitrous or urinous parts; or which partake of the nature of our crude common salts, and Kali's mineral, or other. This would enable us to pronounce, *where*, and *how* we may apply them with safety and success; for some we know are plainly exitial and deadly to plants, (such as the mineral) others properate too fast, and some are sluggish and scarce

advance them at all*. It should therefore be considered, whether any salts do universally nourish all plants alike; or rather partly, some one plant, some another; for upon the clear decision of this secret depends all that is truly curious in this affair; laying, as I do, for position, that the improvement of all the Earths and soils I have spoken of, results from some salt or spirit (call it which you please) as from an indispensable principle in this vegetation, and perhaps the first rudiment of life in all things else; and till we shall arrive to this, (by what I have observed in the discreet use even of our common salt, brine, the effects of urine, and the like) I firmly believe that were saltpetre (I mean factitious nitre) to be obtained in plenty, we should need but few other composts to meliorate our ground; since whether that which so fertilizes it, by any mixture we can yet devise, effect it from any other cause, is greatly to be doubted; nor do I think but the charge of extracting it (at least sufficient to impregnate water in convenient quantity) might be compassed by the industrious farmer without much inconvenience, or difficulty, were he competently instructed in the process of calcination, resolution, percolation, evaporation, and separation, put into honest *English*, and easily to be learned; soon we should then see that this were not to be extracted altogether out of stinking dung, and found in heady trash, (which yet is material) but rather in the well-impregnated and natural Mould itself, charged with a more generous spirit, or medicinal nitre, (in congress with a certain sulphur) capable of warming and exciting to vegetation, beyond all we can promise from any mere artificial ferments, much less our common mixtures and ways of stercoration, which in time grow cold and languish, and are so quickly checked†.

N O T E S.

* Without multiplying distinctions, we may divide manures into four kinds:

1. Such as give nourishment only; as rape-dust, foot, malt-dust, blood-compost, horn-shavings, pigeons dung, and all top-dressings.
2. Such as give nourishment, and add to the soil; as horse dung, cows dung, human ordure, rotten animal and vegetable substances.
3. Such as open the soil, and do not nourish in their own natures; as lime, light marls, sand, and vegetable ashes.
4. Such as stiffen the soil, and at the same time nourish a little; as clay, clay marls, and earth.

† All the boasted compositions of nitre, and other salts, for increasing the fertility of land without other assistance, are now experimentally found to be of little value. Dung, that is, putrid animal and vegetable substances, constitutes the only fertilizer for the use of the farmer. I must however except the oily manures, as rape-dust and foot, which nourish without undergoing the putrid ferment. And here I beg leave to

And now, after all this, I dare not say that there is nothing more than this mere salt, or spirituous nitre, which concurs to those desired effects that promote fertility, and set the ferment on working: What ignite particles beside, and special composts there may be of consanguinity and near alliance to the respective vegetables, (which we know to be of vast difference one from another) we pretend not to determine; for some plants are very brisk and quick, others insulse and flat; some are acid, others more dulcorous and sweet; they are salt, sour, luscious, austere, hot, bitter, moist, dry, astringent, and of strangely different qualities, not to speak of their effects, which it were hard to number. Therefore, that the same compost, or remedy, should be promiscuously universal, is the more unlikely, and should be well considered: But admitting this to be salvable, and that we find, by experience, a well-digested compost beneficial to almost all the vegetable family, may it not in all probability spring from its participation of all those varieties of ferments, (in some at least, though in different proportion) which we have been speaking of? As by which each single species draws and assimilates that only to itself, which it finds most congruous to its nature; and if so it be, then we have no more to do than to learn how to prepare our ferments, and apply them accordingly; namely, acid to acids, sweet to sweets, benign to benign, and so the contrary, as we would promote its natural quality; and this perhaps either by reducing some parts of them into composts, as their leaves, stalks, fruit, or by some more refined extraction of their salts, conveyed in proper vehicles. And for the better administering of this, the nicer texture of vegetables should diligently be considered, their several vessels and organic parts, since every impregnate liquor is not presently fit for all alike, the figuration of their Labiola and curious pores (which it is likely draw several juices and spirits) being very different, as the most sagacious Dr. Grew, and learned Malpighius, (both ornaments of this illustrious Society) have begun the way to us in those elaborate anatomizations, which the world will shortly admire. I insist the rather on this, because we find some plants to reject divers rich compounded liquors, especially such as pretend to work miracles in the Protean changes of colours, and other qualities, from mineral, or other substances; and that the very rains and dews differ in several climes: so as even from

N O T E S.

be understood as agreeing that worn-out lands may in time be restored to their former vigor by the influence of the atmosphere, without any foreign assistance; but this is a circumstance not to be accomplished *instantaneously* by the application of nitre, or any other substance whose basis is saline.

this reason alone, to instance in no more, all plants do not easily become denizens in all places;

— *Nec omnis fert omnia tellus.*

I might add to this the niceness of their palates, and fondness to their own homes, and to live some in comfort, some in solitude, some on dry banks, some in watry puddles, and some as it were in the very air, and fiery soils; nay, some are found to destroy the vegetable virtue where they grow, for such are said to be woad, hemp, the Scythian lamb*, &c. and if this be true and constant, all our imbibitions of salts and composts signify little to Earth pre-impregnated with a salt or virtue different from what the plant does naturally delight in, some obscure footsteps of which every ploughman seems to discover, which makes him change the crop in some places yearly: For the first, second, or third burden of the same grain, especially wheat, will exhaust that which is its proper aliment, and then leave the rest to more ignoble grain, which will be found to thrive well enough, till at last several successions of different seeds quite wear it out, and then the land must repose, or be manured with composts for fresh life and vigor†. And to this we may add, how some plants again

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* This vegetable is called the Tartarian Lamb, from its resemblance in shape to that animal. It has something like four feet, and its body is covered with a kind of down. Travellers report that it will suffer no vegetable to grow within a certain distance of its seat. Sir Hans Sloan read a Memoir upon this plant before the Royal Society; for which consult their Transactions, N°. 245, p. 461. Mr. Bell, in his "Account of a Journey from St. Petersburg to Ispahan," informs us that he searched in vain for this plant in the neighbourhood of Astrachan, when at the same time the more sensible and experienced amongst the Tartars treated the whole history as fabulous. This journey was undertaken in the year 1715.

† It does not seem a well-founded opinion, that plants of different kinds select different particles from the same Earth. Accurate experiments rather prove that they all live upon the same general food. Some require more, some less. Some take it near the surface, others take it deeper. Upon these principles we may rationally account for the necessity of changing the species in the old husbandry. With regard to the different tastes and odours of different plants growing upon the same bed of Earth, I shall only remark, that the modification of the particles of the general nutriment produces all the differences. Matter considered as matter, has no share in the qualities of bodies. It is from the arrangement of it that we have so many substances in nature. We may eat the earth, and drink the water that moistens it, and yet from the modification of its parts by the different vessels of plants, it is capable of becoming both bread and poison. A lemon grafted upon an orange stock is capable of changing the

require little change or help of art, such as most of the perennial greens, and amongst these the most resinous and oily, as the pine, fir, cedar, &c. which thrive on barren hills, and grow in rocky crannies, without any Earth almost to cover and protect their roots. Of this sort I have a cedar table, which was sawed out of a spur only of a monstrous tree growing in Barbadoes, which held six feet long, five feet broad, and three inches thick, formed and wrought as it stands upon the frame; and his Royal Highness had another of a much larger dimension; namely, eighteen feet in length, and nine in breadth, cut out of the stem, which was of prodigious growth, fed and nourished as it was between the barren rocks. But to proceed; we find that most esculent and culinary roots do rather chuse a rich, natural, and light Mould, inclining to sand, than what is forced or over-mucked; and how much they yield to soil, growing hard, short, and fibrous, and contract the smell and relish of the ferments applied to accelerate their growth (for according to the Italian proverb, *Ogni pianta serba della sua radice*, "Every plant has a smack of the root") I have already mentioned; so as to confide in dungs, as our vulgar gardeners about this city do, is no encouragement; and therefore some, not without good reason, prefer the corn and grain which is reaped from marl, chalk, lime, and other more natural manures, before what is produced from a crop which, in comparison, grows on a dung-hill; experience also shewing, that the cause of smuttiness many times proceeds from the impurity and rankness of the dressing; and therefore we omit to enumerate, amongst our soils, *stercus humanum*, which howsoever preferred by some before all other, and mentioned by Columella with that of fowl and cattle, does (unless exceedingly ventilated and aired) perniciously contaminate the odor of flowers, and is so evident in the vine, as nothing can reconcile it*.

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sap of the orange into its own nature, by a different arrangement of the nutritive juices. The same mass of innocent Earth can give life and vigor to the bitter aloe, and to the sweet cane; to the cool houseleek, and to the fiery mustard; to the nourishing grains, and to the deadly nightshade.

* This is the richest species of manure that possibly can be introduced into the field. In Flanders they use it with great success, either strewed upon the land in the form of powder, or dissolved in water and thrown on with a wooden scoop. In large families, this excellent top-dressing may be easily prepared by filling the pits of the *Necessaries* with Moor-Earth, and in this state it may be put upon the land with great advantage and cleanliness.

To give some instances of the nature of particular and simple composts, (for so I beg leave to use a solecism) whatever they be, they are by no means fit for the earth and use of the husbandman, unless, besides their richness, they be perfectly well digested, made short, sweet, and almost reduced to a crumbling Mould; so ordered, as not only not to lose any of their virtue, but to improve it, and to excite, entertain, and communicate heat and vegetative spirits to whatever you apply them: and that this is not done *per se*, that is, by immediate application, without prejudice (unless it be for the hot-bed, which yet has an *intermedium* of Mould) experience tells us, especially in the soil of animals, which is of all other the most active, as consisting of heterogeneous parts and repugnances, without which no fermentation could be obtained. Now, since many of these being freshly made, are not sensibly hot, but mordacious and burning, they are with caution to be used. That every kind of Earth (as well as the dung of beasts, &c.) has its peculiar ferment, and operates accordingly, either by attracting something to it, or embasing what approaches it, sufficient has been said; together with directions how to mingle and attemper it, as best may qualify it for culture. That we may do the like with the several sorts of soil, let us consider what their natures are, what their correctives, and how to apply them.

Horse-dung, the least pinguid and fat of any, taken as it falls, being the most fiery, excites to sudden fermentation above any; wherefore, as we said, it is then fit only for the hot-bed, and when that fervour is past, may be spread on fields where we would have a rank grass to spring; but is at no hand to be admitted into the garden, or where you desire good roots should grow, unless the ground be very stiff, cold, or wet, and then too it had need be well rotted, lest, instead of curing it, it leave couch-grass and pernicious weeds, worse than the disease. The seeds of hay and other plants, of which the horses eat, come oftentimes entire from them; and we observe, that such vegetables do commonly spring up from the soil of cattle as they chiefly eat; as long knot-grass from this beast; short, clean, and sweet pasture from sheep and cows; the sonchus, or sow-thistle, from the swine. Ground mucked with horse-dung is always the most infected of any, and if it be not perfectly consumed, it makes your roots grow forked, fills them with worms, and imparts to them an unpleasing relish; but being laid on at the beginning of winter, and turned in at spring, it succeeds sometimes with pulse.

The dung of asses is highly esteemed, for its better being digested by the long mastication and chewing of that dull animal; but since we have no quantity of it in this country, it does the less concern us.

Neats dung, of all other, is universally the most harmless, and the most useful; excellent to mingle with sandy and hot grounds, lean or dry, and being applied before winter, renders it the most like natural Earth, and is therefore for the garden and orchard preferred to any other. To use it therefore with the most certain success in such thirsty grounds, apply a plentiful surface of it, so blended, as the rain and showers may wash in the virtue of it thoroughly; but this is best done by making the dung the finer, and what if reduced to powder, sprinkled for the garden, or otherwise working it in at a soaking wet (not stormy) season; but leave it covered with it for some time, if the rain descend in too great excess.

The next is sheeps dung, which is of a middle temper between that and pigeons; profitable in cold grounds, and to impregnate liquors, of choice use in the garden.

The dung of swine is esteemed the coldest and least acrimonious, (though some there be who contradict it) and therefore to be applied to burning lands; but always so early interred as never to appear above ground, where it is apt to produce weeds in abundance, from the greedy devouring of what that animal eats.

This, though not so proper for the garden, (and the most stinking) is said yet to edulcorate and sweeten fruit so sensibly, as to convert the bitterest almond into sweet, and therefore recommended, above all others, for experiments of change and alteration: Some qualify it with bran, or chaff well consumed, greatly comfortable to fruit-trees, but especially the hairs and bristles buried about the roots of pear-trees.

Pigeons dung, and that of poultry, (especially of aquatic fowls, which is too fiery) being full of volatile salts, is hot and burning, and therefore most applicable to the coldest ground. There is nothing more effectual to revive the weak and languishing roots of fruit-trees than this laid early to them; but first be sure they pass their mordicant and piercing spirits, and be discreetly mixed: Be this therefore observed as a constant rule, That the hotter composts be early and thinly spread, *à contra*, the colder.

Very efficacious is this dung to keep frosts out of the Earth, and therefore of great use to cover the Mould in cases of exotic and tender plants; but if the heat be not well qualified, the very steam will kill them in a moment; therefore let a full winter pass over this lætation for most uses. The best way of preparing it, is to reduce it into powder, and mingle it with the Mould, and to water with its infusion, which alone does wonders; or, if it has been well exposed and abated, you may use it at the spring without addition; but if you desire something that is exquisite, macerate it well rotted in the lees of wine, stale urine, and a little brimstone beaten very fine, then mingle it with your Earth, for one of the richest composts. But let this be noted, that, as the effect of this dung is sudden, so it lasts not long, and therefore must the oftener be renewed.

The flesh of carrion and dead animals, being (as I think my Lord Bacon tells us) prepared already by so many curious elaborations of its juices, is highly effectual; but it should be very well consumed and ventilated, till it have quite lost its intolerable smell, and therefore never applied too crude*.

Blood is excellent almost with any soil where fruit is planted, especially the Mural. To improve the blood of the grape, it is of great advantage, being somewhat diluted, and poured about the roots. It has been assuredly reported by divers eye-witnesses, that after the battle of Bodmin Fields, in Cornwall, (where Sir Ralph Hopton obtained a signal victory) the carnage being great, the blood of the slain did so fertilize the fields, where corn had been sown a little before, that the year following produced so extraordinary a crop, as most of the wheat-stalks bare two, three, four, yea seven, and some even fourteen ears; a thing almost incredible. The owner of the land seeing his ground so miserably trodden by the horse and soldiers after the conflict, intended to resow it, as believing

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* The offal of the shambles, when mixed with earth and fresh horse dung, makes a compost of the richest quality; but this cannot be obtained in large quantities. Some years ago, I recommended a compost, the basis of which was whales flesh, after the oil had been taken from it. This, compounded with horse dung and earth, is now much used by the farmers who live in the neighbourhood of sea-ports where ships are fitted out for the Greenland seas. The manner of preparing this rich kind of manure is described in the *Georgical Essays*, page 385.

all his former labour lost; but, being dissuaded from his purpose, (perhaps to make the experiment) it happened as you have heard *.

Urine, for being highly spirituous and sharp, had need be well corrected; and then, being mingled with other composts to allay its acrimonious salt, it hardly has its equal.

Hair, horn-havings, bones, skins, leather, &c. are deeply to be buried, and so as not to touch, but lie about the roots: These, with rags, coarse wool, and pitch-marks, improve the Earth, as being full of volatile salts, drawing and retaining the dews. Fish is likewise spread to great advantage of grounds, where it is to be had in plenty; and for being quickly consumed, may soonest be applied †. We come now to vegetables.

The marc and pressings of the grape make a good compost, and so do lees of wine mingled with Mould. This is of singular comfort to the roots of orange-trees and case plants; and if you sift a little brick-dust with it, and bury it near the roots of rosemary, the plant will thrive wonderfully: It may be a laudable compost for moist grounds, where that vegetable grows so unwillingly.

The leaves of trees are profitable for their own fruit, and natural, being well rotted, and not musty: The peach leaf, hurtful to cattle, is excellent for the tree from which it falls; and the walnut leaf, noxious to grass, is helpful to the tree.

Duck-weed, the slime and spongy ouze of stagnant waters, mixed with proper Mould, make a kind bed for aquatics.

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* Blood, mixed with saw-dust, makes a very good hand-dressing to be sown upon wheat in the spring. It equals foot, and does not come to half the price.

† In all towns upon the sea-coast, the refuse of fish may be obtained upon moderate terms. It is matter of surprize that this hint of our excellent Author, given in the year 1675, should have operated so little that at this time (1778) the use of refuse fish is hardly known. The sea, with generous bounty, throws at the feet of the husbandman her richest treasures, and invites him to partake with freedom; but, instead of embracing the proffered riches, he drives his team to some distant town to purchase, at a high rate, what the watery element offers without a price.

Saw-dust, rotten-wood, found in the hollow of decayed trees, under the stacks, and where trees grow thick together, as in great and old woods, but especially that which is taken out of an inveterate willow-tree, is preferable to any other for the raising of seedlings of choice plants, mixed as it should be with a little loam, lime-rubbish, and Mould, as we have taught. This and the rest being well ventilated, is of great effect to loosen and mellow ground, as tenacious of moisture.

Wood-ashes, rich and impregnate with salts, are fit for wet ground without mixture, and in pasture excellent, not sifted on over thick. In the West-Indies, near Guatimala, Gage tells us their manure is the burning of trees to ashes*. These kill the worm; but in Earth which is subject to over-heat and chap much, ashes and burning composts do but increase the fever, and therefore contrary remedies are to be sought, such as Neats and Swines dung; but not so when lands are naturally or accidentally cold. Wherefore we should endeavour by all means to detect, as far as we are able, the quality predominant both of the Earth we would improve, and the composts we apply, and not throw them promiscuously upon every thing without considering of what temper and constitution they be; for grounds are as nice as our bodies, and as obnoxious to infirmities upon every defect and excess; and therefore it requires skill, and no little study, to be able rightly to marshal this *Materia Medica* (as I may call it) of composts, the virtue of which does sometimes lie very hidden; at least, if it be true which Sir Hugh Platt affirms, that what we all this while seek after, is indeed altogether invisible to human eyes, and to be discerned only by the eyes intellectual, because it is veiled and clad under so many different bodies, whereof some are more ponderous, such as marl, chalk, the dung of beasts, &c. some more light, as their flesh, bones, hair, &c. and some yet lighter, as grain and generous seeds; for in such as have virtue to multiply their own species, that spirit is invested with a very thin and curious integument, as in effect we have instanced in the blood and flesh of animals, so much more powerful for the enriching of land than their dung and excrements—this industrious man computing

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* In Sweden, Finland, Livonia, and the greatest part of Russia, where woods are plentiful, the countrymen cut down large tracts, and after burning the wood they sow the land with corn, which husbandry they continue for three years, the wood-ashes remaining in force for that time. On the fourth year they remove to another woody quarter, and in this manner they proceed till the first sown land be again covered with wood, which is generally in about twenty years. This operation is called in the north, *Swedieland*. See *Osbeck's voyage to China*, p. 50. vol. 1.

it to no less than twenty times; and to the same advance above this, hair, wool, and calcined bones*. As to the coarser soils, he says, that the dung of pigeons and poultry does *as* far exceed that of beasts which feed on gross vegetables, and tells us it has been found upon experience, that one load of any sort of seed contains as much virtue as ten loads of ordinary dung; therefore it is advisable, upon all removals of corn-ricks, haystacks, &c. that the husbandman reserve all he can of the bottoms, offal, and shakings, and, mingling them with chimney soot and blood, let him reduce the whole into the form of a paste. To this add as much dried

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* Bones should by no means be calcined, as their virtue is dissipated by the fire, and nothing but a *caput mortuum* left behind. My worthy friend, Gen. St. Leger, has favoured me with the following account of bones used as manure. The subject is curious as well as important:

“ Eight years ago I laid down to grass a large piece of very indifferent lime-stone land with a crop of corn: and, in order that the grass-seeds might have a strong vegetation, I took care to see it well dressed. From this piece I selected three roods of equal quality with the rest, and dressed them with bones broken very small, at the rate of sixty bushels per acre. Upon the lands thus managed, the crop of corn was infinitely superior to the rest. The next year the grass was also superior, and has continued to preserve the same superiority ever since, insomuch that in spring it is green three weeks before the rest of the field.

“ This year, I propose to plow up the field, as the *Festuca Sylvatica* (*Prye Grass*) has overpowered the grass-seeds originally sown. And here it will be proper to remark that, notwithstanding this species of grass is the natural produce of the soil, the three roods on which the bones were laid have hardly any of it, but on the contrary have all along produced the finest grasses.

“ Last year, I dressed two acres with bones in two different fields prepared for turnips, sixty bushels to the acre, and had the pleasure to find the turnips greatly superior to the others managed in the common way. I have no doubt but these two acres will preserve their superiority for many years to come, if I may be allowed to prognosticate from former experiments most attentively conducted.

“ I also dressed an acre of grass ground with bones in October (1774) and rolled them in. The succeeding crop of hay was an exceeding good one. However, I have found from repeated experience that, upon grass ground, this kind of manure exerts itself more powerfully the second year than the first.

“ It must be obvious to every person, that the bones should be well broken before they can be equally spread upon the land. No pieces should exceed the size of marbles. To perform this necessary operation, I would recommend the bones to be sufficiently bruised by putting them under a circular stone, which being moved round upon its edge by means of a horse, in the manner that tanners grind their bark, will very expeditiously effect the purpose. At Sheffield it is now become a trade to grind bones for the use of the farmer. Some people break them small with hammers upon a piece of iron, but that method is inferior to grinding. To ascertain the compara-

neats dung, tempered with urine, and made up in cakes as big as household loaves; and after all is well dried in the shade, crumble the mass to dust, to be sifted or sprinkled on the ground for a very considerable improvement; we say sprinkled, because it should never be sown too thick, especially for corn, which it either cloyes or over heats, according as it is qualified *. Thus, pigeons dung burns seeds on hot ground, but is excellent for barley, &c. sown on the colder Mould.

Of like effect is Earth blended with malt dust, or decayed corn reduced to meal; so is the dust of old furze-bushes, (in Devonshire called *Dress*) but this last should not be taken in seed-time, lest it infect the ground with a plant not easily to be extirpated.

Lastly, the mud of ponds and stagnant waters of ditches, shovelled up and well aired, is best applied to roots of trees, but especially the dust of

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“tive merit of ground and unground bones, I last year dressed two acres of turnips
“with large bones, in the same field where the ground ones were used; the result of
“this experiment was, that the unground materials did not perform the least service;
“while those parts of the field on which the ground bones were laid were greatly bene-
“fited.

“I find that bones of all kinds will answer the purposes of a rich dressing, but those
“of fat cattle, I apprehend, are the best. The London bones, as I am informed, under-
“go the action of boiling water, for which reason they must be much inferior to such
“as retain their oily parts; and this is another of the many proofs given in these essays
“that oil is the *food* of plants. The farmers in this neighbourhood are become so fond
“of this kind of manure, that the price is now advanced to one shilling and four-pence
“per bushel, and even at that price they send sixteen miles for it.

“I have found it a judicious practice to mix ashes with the bones; and this winter
“I have six acres of meadow land dressed with that compost. A cart load of ashes may
“be put to thirty or forty bushels of bones, and when they have heated for twenty-
“four hours (which may be known by the smoaking of the heap) let the whole be
“turned. After laying ten days longer this most excellent dressing will be fit for use.”

Georgical Essays, p. 461.

My very excellent friend, Edward M. Mundy, Esq; of Shipley, in the County of Derby, this moment informs me, that a Gentleman in the neighbourhood of Matlock has lately erected a mill for grinding Bones, which he profitably applies both to pasture and arable lands.

* These observations of Sir Hugh Platt, relative to the nutritive powers of all kinds of *seeds*, are fully confirmed by the present practice of using the powder of *rape cakes* upon corn lands. This species of manure is much used upon the thin lime-stone lands in Yorkshire. They generally use four quarters per acre for wheat, and three quarters for barley. It is harrowed in with the grain, and costs about fourteen shillings per quarter.

unstone highways, where the drift of cattle and much passage is. Let it be carried off from March to November; for, it being already a kind of refined soil, continually stirred and ventilated, there is no compost preferable to it for any use. It is prepared in the highest degree, and will need no wintering, but may be used immediately; and so may straw, haulm, and other litter trampled on in dirty streets, after it is a while rotted and mingled*. Mr. Ray tells us, that in some places about the Alps he found them sowing dust upon the snow, as he supposes for manure, and to fertilize the dissolution.

Thus with no little industry are found out the several kinds of composts, and materials of improvement, and what is the most genuine and true medicament of every soil for arable, pasture, or garden. I do not say all, as if I thought there were no more; for what if indeed there should be as many sorts of composts as there are of ferments or salts; and as many sorts of salts as there be of vegetables, or any other putrifiable matter? The more there be, the greater ought to be our industry and skill to be able to distinguish them, and to know how and when rightly to apply them.

Nor is it sufficient to consider the nature of the Earth, Mould, and several composts, but of the very plants themselves, for the application of what you administer, be it for food or medicine; as if they be cold of constitution, to make use of the hotter composts; if hot, to prescribe the cold. For instance in a few of the most useful only.

Fruit-trees do generally thrive with the soil of neats and hogs; most flowers, but especially roots, with that of sheep. Peter Hondius tells us (in his book intitled *Dapes inemptæ*) that by the sole application of sheeps dung he produced a raddish root in his garden as big as half a man's middle, which being hung up for some time in a butcher's shop, people took for an hog.

Apples affect a pretty rich soil with a dash of loam, but they will bear even in clay well soiled, and mixed with chalk, especially the more hardy

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* The Directors of our turnpike-roads very judiciously rake into heaps the pulverized materials. These, when carted off, make an excellent dressing for grass grounds, and probably may be used with advantage as a top-dressing for wheat in the spring.

winter fruit; and in chalk alone for some years; but they produce, though sweet, not so large fruit: But both apples and pears have a better relish in grounds that are not over moist, and where they may stand warm: and the last will prosper well enough where the soil is mixed with gravel, and has an harder bottom.

Cherries, summer and stone-fruit, such as have their roots like thrums, desire a fine light Mould, sand or gravel, with chalk and good compost, unless it be very coarse and stony; in which case it should be well soiled, and the pit you plant in filled with rich Mould, as far as the roots are likely to extend before they reach the gravel, so as to make good spread; and this is to be renewed every third or fourth year; and for this reason it is profitable sometimes to bait sterile grounds, by laying your composts at reasonable intervals, thereby to tempt and allure the roots towards it, and keep them from wandering, which they will be subject to do in search of fresh nourishment: For to bear constantly well, and much, fruit-trees must have frequent lätations. Nor are we to judge that what is excellent ground for one sort of vegetable is so for another; since that which is perfectly good for corn, is not so for all fruit-trees; and a slender straw will be fed and brought up with a great deal less substance and virtue, than what will serve to furnish the stem, bulk, and head of a fertile and spreading tree.

The Vine (than which no plant more sensibly retains the different qualities of Earth, or whose juice is of more variety) rejoices in a light, but vigorous, Mould, rather sandy, and inclining to dry, than either fat, luxuriant, or moist. Lime tempered with blood exceedingly recreates it, after the first heats are passed over.

Fig-trees (though affected to dry grounds) are no lovers of stercoration; yet in some countries they apply olive oil and doves dung to cause them to bear early fruit; but omitting the oil, if the dung be mingled with lime and ashes, it is not to be reproved: This fruit thrives and ripens even in the shade, and in our northern exposures in the meridional parts of England; but much better in the south, and best of all in cases, and under shelter in winter; an industry worth the pains for the most delicious fruit in nature, were it skilfully cultivated.

Artichokes thrive exceedingly with sheeps dung, which, applied to the roots, make them produce very great heads: In the island of Jersey they use sea-wreck, to a wonderful improvement of that plant.

Melons, asparagus, and most hasty growers, participate evidently of the soil, and therefore we have already shewed how new and heady dung contaminates; and this is, amongst other, the reason why in the more southern countries (where they are planted in the natural and unforced Mould) they are so racy, and superior in taste and flavour to ours. I should therefore recommend the use of sheeps dung, well reduced, or rather the ashes of burnt straw, and the hotter dungs calcined, for some trials to reform it; or, as they do in Italy, mingle dust and Earth manured with sheeps-soil and wood-ashes; if, after all we have said, the cause of our application of composts and dungs to these rarer and choice productions be not to prevent the rains only; for otherwise too rich soils impair the most delicious fruits, rather than improve them; and grapes and other fruits are sooner ripened which stand near the highways, much beaten by passengers, than by all that you can lay to the roots, or spread on the ground for that purpose, the dust investing both the tree and fruit with a kind of refined soil, mellowed with the dews and gentle showers which fall from heaven.

To give some instances, Roots, as we have shewed, desire deep ground; fruit-trees should never go deeper than the usual penetrations of the sun, for no farther is the Mould benign. Besides, they but too propensely sink of themselves, especially bulbs of flowers, whose fibres easily draw them down, and then they change their artificial and accidental beauty, and (as we call it) degenerate; but trees will grow and thrive, if planted on the very surface, with little covering of the Mould, so they be oft refreshed, and established against the wind. Besides, we find that even the goodliest fruit (as well as some timber-trees) have many times the hardest footings with reasonable depth of Earth. So little does it import to have it profound, that, in soft and deeper sands, they thrive nothing so well as on chalk and gravel, so long as the root can be kept from descending; in which case you should (as we have shewed) bait the ground towards the surface, and keep the roots from gadding too far from the stem, for the lower roots are frequently starved by the upper, which devour the nourishment before it arrives at them. Thus gardeners should sometimes humour their plants, cook and dress their foods to their appetite, and as they can well digest; but by no means suffer the roots of fruit-trees, *Standards*, or *Mural*, to be planted in dunged Earth which is not exceedingly well digested, and little different from the natural soil.

To give some other profitable instances of this nature: In transplanting trees (beginning early, and when the Earth is most tractable) endeavour to make your Mould as connatural to that of the place or nursery from whence you remove them, as you can. It is not therefore material it should be so much richer; but where Imp-gardens are poor, the tender plant, like a child starved at nurse, does seldom thrive wherever you set it; and therefore you should have fair and spreading roots, and well fed, whatever some pretend. For other rarer shrubs and plants, the orange (Herrera tells us) thrives well with the ashes of burnt gourds and leaves, and needs not change of Mould, even in the case, above twice a year, and that towards the surface; but the *Anomum Plinii* is a strange waster of Earth, and should continually be enriched and planted as it were all in dung; so the myrtle and pomegranate; whilst the red rose, capers, samphire, and other shrubs and plants thrive better in gravel and rubbish. Sage loves ashes, and purslain delights in dust and sweepings; rue affects the dry Mould, lettuce the moister. Flowers, for the most part, detest the dung-hill, but, if they love any, it is that of sheep or cows mixed with loam and light Earth. Tulips delight in change, and rather in poor than rich Mould, yea, sharp and hungry, to preserve their variegations. But because it is sometimes troublesome to transplant them yearly, place a layer of short stable litter a foot beneath your Mould, and they will remain unremoved for some years without prejudice. The iris loves the dry bed; crocus, a mixed, rich, and light soil; carnations desire a loamy Earth, qualified, if too stiff, with sea sand and sheeps dung; if too poor, with richer Mould; so the peony, anemony, ranunculus, and other flowers; but then lay it at the bottom, such as you take from the last year's hot-bed, giving it a surface of under-turf, which has been foddered on, sweet, and aired. In this plant your roots, but so as not to touch the artificial soil; for all dunged Earths canker the bulbs of flowers, whilst their fibres, reaching the heartier Mould, draw from it without danger. But if you would indeed be provided of excellent Earth to plant most flowers in, lay turf of pasture ground in heaps for two winters, till it be perfectly consumed; this is also admirable for tuberous roots, and indeed all upland Mould, whether sandy or loamy, may be made perfectly good with neats dung laid on the surface about Michaelmas for one year, that it may wash kindly in; then in September after, pare this turf off as thin as you can, and for the first foot deep of Earth, you have bedding for bulbs and tuberous roots superior to any other. Another proper mixture, much in esteem with our gardeners, is Willow-Earth, a fourth part, sifted from the grosser sticks, with almost an equal

portion of sheeps dung, (Laurembergius says goats is better) natural Mould making up the other two parts; and indeed this is excellent to raise any seedlings of flowers; but for the more minute and delicate, such as cypreiss, mulberry, the samara of elm, and the like, prepare a Mould as fine as powder, and let it be gently refreshed with a dewy sperge or brush, not with the watering-pot, which plainly gluts it.

Auriculas, anemonies, &c. should be raised in the Willow-Mould described above, but planted forth where neats dung and loam is sifted among the Pasture-Earth.

The pine and bigger kernels make (as some affirm) great advance by being coated with dung, but, being grown to great trees, they abhor it. Touching change of crop, something has been said already; Pease degenerate betimes, at least in two or three years, be the land never so good; so it is observed, that most plants long standing in the same bed, impair both the ground and themselves, especially sorrel.

To conclude: For a general good garden soil, take the natural under-turf, if it be not too stiff; add to it a quarter part of neat or sheeps dung perfectly consumed; one bushel of slacked lime to each load of Mould, with some sweet, though rotten wood-pile of Willow-Earth; mix these well together, and you have a choice composition for all your rare exoticks, oranges, and case shrubs, remembering to place the spray of rotten bavons, hampers, or baskets, to keep the Mould loose, with limestone, brickbats, shells, and other rubbish at the bottom, that the water may pass freely, and not rot the fibres. And therefore be careful never to make your cases close below, but rather so barr'd as to be able to keep the coarse materials from dropping through, whilst augur-holes, though never so thick bored, are apt to be stopped up, and then your roots do certainly rot, and your trees grow sick. The same is to be observed in pots, and that you place them about an inch from the ground, that they may freely drain, and as freely receive refreshing. But I must not quit these curiosities, to speak of the cooler composts, till I have described the best hot-bed that I know of.

Dig a pit or fosse, hot-bed depth, (four feet is sufficient) and of what figure and dimension you think will best entertain your furniture for it; if it be twenty feet in length, and ten broad, I think it competent. Line the sides with a wall of brick and half thick; fill this pit with fresh soil

from the stable, trodden as other hot-beds are, but without any Mould on the surface. On *this* place half-inch wooden cases, made like coffins, (but not contracted at the extremes (nor lidded) of what length and breadth you think best, but not above a foot in depth; let these be dove-tailed, with wooden handles at each end to lift in and out, and bored full of augur-holes at the bottoms. Your cases thus fitted, fill them with proper Mould, such as you would sow melon seeds in, or any other rare seed, and thus place them in your bed of dung. The heat will pass kindly through the perforations, and continue a cherishing warmth five times as long as by the common way of hot-bed, and prevent you the trouble of making new and fresh for the whole process of the melon, or what other of choicer plants require more than one removal. The heat of this bed continues eight or ten weeks without need of repairing; and if it should, it is but casting in some fresh-made soil and litter beneath and about your cases, of which some you may glaze cheveron-wise at the top, and with spiracles or casements, to refresh and give them air and sun at pleasure. And these beds, where you cannot conveniently sink them for want of depth because of water, you may build above-ground as well; and you may, or may not, extend a tent over them, to protect them from rain, wind, and sun, according as you find occasion. Thus have you a neat and useful hot-bed, as I have been taught to make it by the Right Honourable the late Lord Viscount Mordaunt, at Parsons-Green, whose industry and knowledge in all hortulan elegancies require honourable mention. *Note*, That ordinary fresh Mould, so it be not poor and very lean, or apt to clog, is a better surface for the hot-bed to entertain and cherish the most curious feeds, than what gardeners universally make use of, sticky and over loose; at least let a due proportion of natural Earth be sifted amongst it.

Being now at last come to set down the several ways of preparing composts of dungs, and those other ingredients we have mentioned, we shall begin with the rudest, as that which best accommodates to the grosser part of husbandry, (which yet requires a special maturation) and so descend to the more refined. These I distinguish into the moist, the dry, and the liquid for irrigation. But first, here by the way, greatly to be reprov'd is the heaping of a deal of undigested soil, and other trash, exposed (as we commonly find it) to the heat of the sun, continual rains, and drying winds, as it lies in the wide field, without the least coverture or shade; by which means all the virtue is drawn forth and carried away, leaving little more than a dry and insipid congestion of *caput mortuum*, and per-

haps a florid green circle, or fairy dance, at the bottom, which the impregnated rains have enriched with what has washed from the heap; wherefore to prevent this, and make one load of our prepared soil worth ten of it:

Cut a square, or oblong pit of thirty or forty feet in length, at the least four feet in depth, and ten feet over, or of what dimensions or figure you think will suffice to furnish you with store: Let one of the sides or edges be made so sloping, as to receive a cart or wheelbarrow to load and unload easily, and let the bottom and sides also be so well paved, or laid with a bed of small chalk, clay, or the like, that it may be capable of retaining water like a cistern: If to this you can commodiously direct any channels or gutters from your stable, and other sinks about the house, it will be much the better. The pit thus prepared, and under covert (for that I should have premised) so as at least the downright rains may not fall upon it (but when you please); cast into it, first, your stable soil with the litter, a foot or more thick, according to the depth of your pit; upon this lay a bed of fine Mould, on that another bed of cyder-marc, rotten fruit, and garden offal; on this a couch of pigeons and poultry dung, with more horse dung; then a stratum of sheeps dung, a layer of Earth again, then neats dung; lastly, ashes, foot, fern, a moist and dry bottom of wood-stack, saw-dust, dry scourings of ponds and ditches, with all other ingredients, as you happen to amass them, till the cistern be full and heaped up; upon all this cast plentiful water from time to time, which if you can have out of some pond where cattle use to drink and cool themselves, it will be excellent. At the expiration of two years you may confidently open your magazine, and separate the layers as they rise, to cast them into other small pits or receptacles made a little concave to receive them, where you may stir, air, mingle, and work them in with fresh Mould, or one with the other, as you find cause, till they become comparatively sweet and agreeable to the scent. Lastly, you may pass them through a screen made of laths placed at moderate intervals, and with the liquor remaining in your great cistern sprinkle the several composts, and make them up for use, casting the coarse remaining stuff, which would not pass the riddle, into the cistern again for farther mortification, and so keep your pit filled with fresh materials from time to time after the same method: Others, in the mean-time, lay their several ingredients by themselves in some shady corner, which being

frequently stirred, after two or three years thus mingle them at discretion *.

There are some who advise us to suffer our mixture to remain till it be quite dry, after it is thus refined; and then, being beaten to dust, to strew it upon the ground. And indeed this seems in Pliny's time to have been the custom; nor do I contradict it, provided you could water it, or were sure of a shower before the sun had drank too deeply of the spirit and vigor of it, which, reduced in this manner, it does easily part with.

Now the reason of our thus treating composts of various soils and substances, is not only to dulcify, sweeten, and free them from the noxious qualities they otherwise retain, and consequently impart, when applied, as usually we find them, crude, undigested, and unactive; but for being immoderately hot and burning, or else rank, and apter to ingender vermin, weeds, and fungous excrescences, than to produce wholesome plants, fruits, and roots, fit for the table, and grateful to the palate; for which effect it should be thoroughly concocted, aired, of a scent agreeable, and reduced to the next disposition of a sweet and natural Earth, short and tractable, yet not so macerated as to lose any of its virtue. The proper season therefore for this work, is the beginning of the autumnal equinox, and wind westerly, both to prepare and lay it on your land, that, whether it be of wet or dry consistence, it may have a gentle soaking into the Earth. As for fresh dung, such as sheep make when they are folded, it is good advice to cover it with Mould as soon as possible, before the sun has over-dried it, for the reason before hinted †; and by this early application you will find all that is stiff and any ways contumacious, subdued and perfectly prepared before you turn it in. If you would meliorate ground for fruit-trees of the orchard, or roots and esculents of the olitory garden, be cautious that the hotter dungs approach not immediately to

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* In large families a rich species of manure may be collected, by supplying the pits under the *Necessaries* with vegetable offal from the gardens, and fresh Mould from the commons. We cannot pay too much attention to the formation of compost dunghills, for, without their assistance, the utmost exertion of the plow would but little avail. In this particular the farmer should be scrupulously nice, and he should embrace every opportunity to improve his stock of dung.

† In this manner plenty of rich compost may be raised. Some people bed the ground, on which sheep are folded, with sand, which enables them to remove the rich manure to any distant place at pleasure.

their stems or roots, without such a circumscription of natural Mould as we have commended. But this is a note for such as think fit to use the soil *steaming* as it comes from the heap; but, if it be prepared as we have shewed, there is no danger even of immediate contact. And the same is to be observed in ablaqueation, where we find cause to bare the roots of trees, and expose them to the air for fresh influence, or to abate exuberances; and that the cavity be not filled all at once, (when we conceive the roots have been sufficiently aired) but gradually from month to month, as from October till the beginning of March; and, upon other occasions, leaving the surface rough, rather than too compt and exquisitely trimmed, if only you dig your ground, which once in two or three years, four or five, (as you perceive your trees to require culture) is advisable, and then to mingle the Earth with a thorough soiling, and refresh it with the impregnate water of your cistern, will exceedingly recover a worn-out plantation. This irrigation may also be yearly given to the roots of your fruit-trees about June and July; and the spreading of a little good soil upon the surface, and rough chopping it in with the spade before winter, is good husbandry, for it draws the roots upwards, the shallow running of which is of so great importance. But of this already.

And thus having shewed how to prepare, ripen, separate, and apply the several composts (which for distinction sake we call the dry mixture) I am next to describe the liquid, in many particulars not much differing from the former process.

Betwixt east and north erect a Pergola or Shed, so contrived with a cover as to exclude, or admit, the rain, snow, and weather at pleasure; under this, sink a pit for the cistern, into which cast all the acid plants, bitter and rank weeds that come in your way, and grow in the neglected corners of your grounds, such as esula, hemlock, docks, thistles, fumitory, tobacco-stalks, wormwood, cabbage leaves and stalks, aconites, the leaves, trash, and offal, such as cattle will not touch; to these add pigeons and poultry dung, with their quills and feathers; all sorts of ashes, soot, hogs hair, horn, bones; also urine, blood, garbage, pickle, brine, sea water, (if conveniently to be had) otherwise pond water, to sprinkle it with, and keep it moist to accelerate putrefaction; but when all is well consumed, forbear the pouring on of insipid liquors, and thus leave it till it be dry; then air, mingle, and work your composts as you were directed above, or boil it into petre, casting what you find not well digested into

the cistern again for another year, and, with a little addition, it will give you half the quantity of the former, and, provided that you supply the magazine, a continued and farther increase. Indeed this salt and compost is not immediately fit for use, till it be well dulcified and purged from its over acrimony, therefore mix it well with your Mould, and dilute it as you see cause. The receipt is set down by old Glauber for the effecting of wonderful vegetation, by the assistance of certain circulatory vessels to prepare the oily succus, and pinguid juice, which that author teaches in his *Miraculum Mundi*, to extract not only out of these materials, but out of turf, wood, and stone itself, by calcining and burning them in close and reverberating furnaces, to which a tube, adapted near the bottom, may convey the spirits into a recipient, as he describes the process. I mention this the rather, for the real effects which I have been told of this menstruum from very good testimony: And doubtless he who were skilled to extract it in quantity, (and to dulcify and qualify it for use) a true spirituous nitre may do abundantly more, in the way of the improvements we have celebrated, with a small quantity, than with whole loads, nay hundreds of loads of the best and richest of dry composts which we can devise to make*. But besides this, any house of ordure, or rancid mould, strong salts, vinous liquors, urine, ashes, dust, shovelings of the kennels and streets, &c. kept dry and covered for three or four years, will be converted into petre without half this trouble, especially if you mingle it with the dung of pigeons, poultry, and other salacious fowl which feed on corn: Or, those who would not be at the charge of distilling for these advantages, may make experiment of the so famous muck-water, not long since cried up for the doing wonders in the field: Throw of the shortest and best marl into your cistern, exceedingly comminute and broken, which you may do with an iron rake, or like instrument, till the liquor become very thick; cast on this the dung of fowl, conies, sheep, &c. frequently stirring it; to this add the soil of horses and cows, grains, lees of wine, ale, beer, any sort of beverage, broths, brine, fat and greasy stuff of the kitchen; then cast in a quantity of lime, or melting chalk, of which there is a sort very unctuous; also blood, urine, &c. mixed with the water, and with this sprinkle your ground at seasonable

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* The whole of this passage is an unnecessary and expensive multiplication of the farmer's trouble; and indeed it seems to have been given by our excellent Author rather in conformity to the philosophy of the times than from his own experience or opinion. The boasted receipts of Chymists for forwarding the powers of vegetation, are now justly exploded, and the present age boasts of a philosophy in farming, that has truth and experiment for its foundation.

times; and when you have almost exhausted the cistern of the liquid, mingle the residue with the groffer compost of your stable and cow-house, and layers of Earth, sand, lime, S. S. S. frequently moistened with un-crude water; the taking up of which you may much facilitate, by sinking a tub or vessel near the corner of the cistern, and piercing it with large holes at the bottom and sides, by which means you may take it out so clean as to make use of it through a great syringe or watering engine; such as is used to extinguish fire will exalt and let it fall by showers on the ground, and is by much the more natural way of irrigation; it also dispatches the work.

This liquor has the reputation also for insuccation of corn and other grain, to which some add a fine sifting of lime-dust on it, and when that is dry, to repeat it with new infusions and siftings: But,

There is yet a shorter process, namely, the watering with fishmongers wash, impregnated with the sweepings of ships and vessels trading for salt, adding to it the blood of the slaughter-house, with lime, as above; but this is also much too fierce for any present use till it be perfectly diluted, which is a caution indispensably necessary whenever you would apply such powerful affusions, lest it destroy and burn up, instead of curing and enriching. Another is as follows:

Take rain water of the equinox, a sufficient quantity. Boil with store of neats dung till it be very strong, then dissolve one pound of saltpetre in every pottle of the water; in this, a little tepid, macerate your seeds for twenty-four hours; dry them gently, rather with a cloth than by the fire, and sow in the barrenest Earth, or water fruit-trees with the liquor, for prodigious effects. Or thus:

Take two quarts of the same water, neats dung, as before; boil to the consumption of half; strain and cast into the percolation two handfuls of bay salt, and as much saltpetre. Another:

Take rain water which has stood till putrified; add to it neats, pigeon, or sheeps dung; expose it for insolation a week or ten days, then pass it through a coarse strainer; infuse more of the same soil, and let it stand in the sun a week longer; strain it a second time, and add to it common salt and a little ox gall. Another:

Take quick lime, and sheeps dung at discretion; put these into rain water four fingers eminent; to ten pints of this liquor, add one of aquavitæ; macerate your seeds, or water with it any lean Earth, where you would plant, for wonderful effects.

Infuse three pounds of the best Indian nitre in fifteen gallons of water; with this irrigate your barren Mould. It was successfully tried amongst tulips and bulbs, where the Earth should by no means (as we have said) be forced by composts. But a gentler than either, is,

A dilution of milk with rain water, sprinkled upon unslacked lime, first sifted on your beds; and so after every watering the lime repeated.

These, with divers more which I might superadd, not taken and transcribed out of common receipt-books, and such as pretend to secrets, but most of them experimented, I thought fit to mention, that upon repetition of trials the curious might satisfy themselves, and as they have opportunity improve them; whilst perhaps, as to irrigations, less exalted liquors were more natural. And what if essays were made of liquors *per lixivium*, the plant reduced to ashes: might it not be more connatural, since we find by more frequent trial that the burning of stubble, before the rains descend on it, impregnates ground by the dissolution of its spermatic salts? I only name the naked phlegm of plants distilled either to use alone, or extract the former salt; but I say I only mention them for the curious to examine, and *ex abundanti*. For certainly (to return a little, and speak freely my thoughts concerning them) most exalted *Menstrua*, and (as they dignify them with a great name) Essentiated Spirits, all hasty motions, and extraordinary fermentations, though indeed they may possibly give sudden rise, and seemingly exalt the present vigor of plants, are as pernicious to them as brandy and hot waters are to men; and therefore wherever these ardent spirits are applied, they should be poured at convenient distances from any part of the plant, that the virtue may be conveyed through some better qualified medium. But, when all is done, waters moderately impregnated and imbodyed with honest composts, and set in the sun, are more safe, and, I think, more natural*; for, as the learned Dr. Sharrock truly affirms, water is, of its own constitution alone, a soil to vegetables, not only as the most genuine vehicle of the riches

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* Here our excellent Author, after enumerating the wild and phantastical opinions of others, at last gives his own, than which nothing can be more just.

which it imparts to plants, through the several strainers, and by means of which all change and melioration is effected, but for that it is, of all other substances, best disposed to insinuate into and fertilize the Earth, which is the reason that floated and irriguous grounds are so pregnant. Besides, it is, of all that pretend to it, nearest of blood (as I may say) to the whole vegetable family. For to assert with any confidence what part of the mere Earth passes into their composition, or whether it serve (as we touched before) only for stability, or as a womb and receptacle to their seeds and eggs (for so we are taught to call the seeds of plants) I shall not undertake to discuss. Every body has heard of Van Helmont's Ash-tree*; and may, without much difficulty, repeat what has been experimented, by exquisitely weighing the Mould before and after a gourd is planted in it, and till it be grown to bulk and full maturity, fed with water only; by knowing how much liquor is infused, and how little of the Earth consumed, some conjecture may be made; though I do not yet conceive the Earth to be altogether so dull and unactive as to afford no other aid to the generation of what she bears; the diversity of soils being (as we have shewed) so infinitely various, and the difference of invisible infusions so beyond our arithmetic. But if we give liquids predominion, at least the masculine preference, be they salts, or spirits (that is, nitrous spirits) conveyed into her bosom how they will; sure we are, that water and vegetables are much nearer of alliance, than either water or air are with the Earth and Mould. But neither do I here also by any means exclude the air, nor deny its perpetual commerce and benign influences, charged as it comes with those pregnant and subtle particles, which insinuating into the Earth's more steady and less volatile salts, and both together invading the sulphur, (and freeing them from whatsoever they find contumacious) that intestine fermentation is begun and promoted, which derives life, and growth, and motion, to all that she produces. That by the air, the most effete and elixivated Mould comes to be repaired, and is qualified to attract the prolific nitrous spirits, (which not only disposes the Earth to this impregnating magnetism, but converts her more unactive fixed salts into quite another genius and nature) the learned Dr.

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* Van Helmont planted a willow-tree, which weighed five pounds, in two hundred pounds of Earth dried in an oven, and watered it with rain, or distilled water, after carefully covering the case in which it stood with a perforated tin cover, to prevent the admission of any other earthy particles. Five years after, he weighed the tree, adding all the leaves it had produced in that time, and found its weight amount to one hundred and sixty-nine pounds two ounces, while the Earth was only diminished about two ounces.

Mayow has ingeniously made out ; and all this by a naked exposure to the air alone, without which it produces nothing : Nor can plants (totally excluded from the air) live, or so much as erect themselves to any thriving purpose, as being deprived of that breath and vital balm, which no less contributes to their growth and nourishment than does the Earth itself with all our assistances : For that plants do more than obscurely respire, and exercise a kind of peristaltic motion, I little doubt from the wonderful and conspicuous attraction and emissions which some of them discover ; particularly the aloes and other sedums, and such as, consisting of less cold and viscous parts, send forth their aromatic wafts at considerable distance *.

Besides, we find that air is nearer of kin and affinity to water than water is to plants, unless I should affirm that air itself were but a thinner water ; for how else are those vines, and other trees of prodigious growth, maintained amongst the barren rocks and thirsty pumices, where rains but seldom fall, if not from this rorid air ? Not to insist again, that perhaps even these rocks themselves may once have sprung from liquid parents ; and how little even such as are exposed to continual showers, in other climates, abate of their magnitude, since we rather find them to increase ; and that also the fruits and juices of vegetables seem to be but the concretion of better concocted water, and may not only be converted into lignous and woody substance, (as the learned Dr. Beale has somewhere instanced in a Discourse presented to you, and recorded in the Public Transactions) but is apt enough to petrify and become arrant stone,

Whatever then it be which the Earth contributes, or whether it contain universally a seminal virtue, so specified by the air, influences, and genius of the clime, as to make that a Cinnamon-tree in Ceylon, which is but a Bay in England, is past my skill to determine ; but it is to be observed with no little wonder, what Monsieur Bernier, in his history of the Empire of the Mogul, affirms to us of a mountain there, which being on one side of it intolerably hot, produces Indian plants, and on the other, as intemperately cold, European and vulgar. Not here to pass without

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* From the experiments of Malpighius, Grew, Hales, and Duhamel, it is abundantly evident that all plants, without distinction, inspire and expire. The leaves perform these salutary operations, so that deciduous trees and shrubs, from the time they lose their leaves to the expansion of their buds, may be considered as in a state of perfect insensibility, resembling that class of animals called *Sleepers*.

notice at least, what even the most exhausted Mould will (to all appearance) produce spontaneously, when once it has been well exposed to the air and heavenly influences, if what springs up be not possibly from some volatile rudiments and real seeds, transported by winds, higher than we usually place our experiments: But Porta tells us, with more confidence, that he took Earth from a most profound and dry place, and exposed it on such an eminence as to be out of reach even of the winds; but it produced, it seems, only such plants as grew about Naples, and therefore may be suspected.

To return then again from this digression, and pursue our liquids; where there is good water there is commonly good Earth, and *vice versa*, because it bridles and tempers the salts, abates the acidity and fierceness of the spirits, and imparts that useful ligature and connection to the Mould, without which it were of no use for vegetation. In the meantime, of all waters, that which descends from heaven we find to be the richest and properest in our work, as having been already meteorized, and circulated in that great digestory, enriched and impregnated with astral influences from above at those propitious seasons; whence that saying, *Annus fructificat, non Tellus*, has just title to a truth we every year's revolution behold and admire, when the sweet dews of spring and autumn (hitherto constipated by cold, or consumed with too much heat) begin to be loosened, or moderately condensed, by the more benign temper of the air, impregnating the prepared Earth to receive the nitrous spirits descending with their balmy pearls, yet with such difference of more or less benign, (as vapours haply, which the Earth sends up, may be sometimes qualified) that nothing is more uncertain. And this we easily observe from the labours of the industrious bee, and her precious elixir, when for some whole months she gathers little, and at other times stives her waxen city with the harvest of a few propitious days. But I am gone too far, and therefore now shall set down only a few directions concerning watering, and so dismiss the subject and your patience.

1. It is not good to water new-sown seeds immediately, as frequently we do, and which commonly bursts them, but to let them remain eight-and-forty hours in their beds, till they be a little glutted with the natural juice of the Earth. But then neither must you so neglect their beds, as to become totally dry; for if once the seeds crack through heat, their little

souls exhale^{*}; therefore till they peep, you must ever keep them in a just temper for moisture, and be sure to purge them of predacious weeds betimes: In a word, these irrigations are to be conducted according to the quality of the seeds, those of hard integuments requiring more plentiful refreshings.

2. Never give much water at one time; for the surface of the Earth will often seem very dry when it is wet enough beneath; and then the fibres rot about autumn, especially in pots and cases, wintered in the Green-house. To be the more secure, we have already cautioned gardeners to keep their bottoms hollow, that nothing stagnate and fix too long, which should be but transitory. If such curiosities strike no root by September, the leaves desert them certainly at spring. The reason is want of air, not moisture. Therefore in all intervals of severe frosts, and rigorous winter-weather, be sparing of refreshings, and unless you perceive their leaves to crumple up and fall, (which is the language for drink) give them as sparingly as you can. Indeed, during the summer, and when they are exposed, they require almost perpetual irrigation, and that the liquor be well impregnated with proper compost. It is ever advisable to water whilst the ground is a little moist, and not totally dry, especially during the growing seasons, for it stunts the plant and intercepts its progress. But in hard frosts, or foggy seasons, watering your housed plants endangers them by mustiness, and a certain mill-dew which they contract. On the other hand,

Applications too dry create an intemperate thirstiness, and then they drink unmeasurably, and fall into dropsies, jaundice, and fevers, swell, languish, and rot; and if the liquor prove too crude, (as commonly it does, if taken from running and hungry fountains) it extinguishes the natural heat, and obstructs the pores; and therefore whenever you are constrained to make use of such drink, expose it first to the warm sun for better concoction, infusing sheep, pigeons, or neats dung, to give it body. But though spring water be so bad, slow-running river is often very good, and pond water excellent, so it be sweet; but all stinking pools, mineral and bituminous waters, are not for our use; and often good air is as needful as good water; worms, mouldiness, cankers, consumptions, and other diseases, being the usual and fatal consequences of these vices.

N O T E S.

* This expression has an uncommon degree of simplicity and beauty.

If you be to plant in fresh and new broken-up Earth, and that the season or Mould be too dry, it is to be watered; but then give a competent sprinkling, or sifting of dry and fine Mould upon what you have refreshed, and then beating it a little close with the back of your spade, plant it successfully; for this you will find to be much better than to water it after you have planted, (as the custom is) and as you may observe in setting violets, auriculas, primroses, and other capillaries, planted in beds or borders, and then dashed with a flood of water, which, so soon as the sun has looked upon, resign and lose their tinctures, scorch and shrivel up. Here therefore let gardeners be cautious how they expose their exoticks and choicer, case-plants, which many times having born the winter bravely in the conservatory, dwindle away, and are lost on the sudden, by being too suddenly placed in the eye of the sun in March, (or later) when they most of all require the protection of a thin hedge, or canvas curtain, to break his scorching darts, as well as defend them from our then too constant and rigorous *Etesians*. Lastly,

For the season likewise of this work, let it be towards the evening in hot and summer days, for the reason immediately assigned; for the moisture being in a short time drunk up, deserts the plant to the burning planet; and hence it is that summer mists and meridian waterings are so noxious; and therefore the best expedient is, upon such exigencies, to pour your refreshings rather all over the area on which your cases of choice and rare shrubs are placed, and among the alleys and paths between your beds of flowers, for the raising artificial dews, (by which is unfolded no common secret) or water them *per lingulam*, and *guttatim*, than either with the pot or bucket: And after this manner, if at other seasons they stand in need of heat and comfort of warmth, by strewing sand or cinders on the same intervals, the reflection will recreate them upon all emissions of the sun-beams.

As for groffer plantations, and trees of old orchard fruits, moderation is also to be observed, and not to dash on such a quantity near the stem and body; but first with the spade to loosen the Earth about them, especially towards the extremities of the tenderest roots, which generally sprout at the ends of the most woody, whose mouths are shut with tougher bark. These therefore may be cut sloping to quicken them a little, and make them strike fresh fibres, especially if some rich and tempting Mould be seasonably applied: For trees will (as we shewed) with very little Earth

to cover them, take fast root (provided you establish them against impetuous winds, shocks, and accidents of force) and thrive exceedingly with this refreshment.

Some make pretty large holes with an iron crow, or (which is better) a pointed stake, and pour the liquor in at those apertures; but by this means they wound the roots, (which gangrenes, and sometimes kills the tree) and if the holes be not filled, the air and moisture occasion mouldiness: So that when all is summed together, there is nothing comparable to frequent stirring the ground, opening the dry clod, and watering upon that; and if you lay about them any fern-brakes, or other trash, capped with a little Earth to entertain the moisture and screen it from the heat, let it not be wadded so close, or suffered to lie so long as to contract any mustiness, but rather loose and easy, for the free intercourse of the air, and to break the more intense ardours of the scorching sun-beams.

Thus I have exercised your Lordship's and these noble Gentlemen's patience with a dull discourse of Earth, Mould, and Soil; but I trust not altogether without some fruit, as the subject has relation to what has so lately been produced, and with happy event made out by those learned persons who have entertained this illustrious Society with the Anatomy of Plants.

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This Day is published,
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✎ The Editor begs leave to inform the purchasers of the former edition of the Silva, that the following are the only Notes of consequence added to the present impression. The page at the bottom of the respective notes refers to the places of the former edition where these notes come in.

The False ACACIA is titled *Robinia (Pseud-Acacia) racemis pedicellis unifloris, foliis impari-pinnatis stipulis spinosis*. Sp. Pl. 1043. Tournefort calls it, *Pseudo-acacia vulgaris*; Ray names it, *Acacia Americana, siliquis glabris*; and Catesby, *Pseudo-acacia hispida, floribus roseis*.

It is of the Class and Order *Diadelphia Decandria*.

This tree is also a native of North-America. Its branches are armed with strong crooked thorns, and garnished with winged leaves, composed of eight or ten pair of oval lobes, terminated by an odd one. They are of a bright green, and sit close to the midrib. The flowers come out from the sides of the branches in pretty long bunches, hanging downward like those of the Laburnum, each flower standing on a slender foot-stalk: These are of the Butterfly, or Pea-blossom kind; are white, and smell very sweet. They appear in June, and when the trees are full of flowers, they make a fine appearance; but they are of short duration, seldom continuing more than a week in beauty. After the flowers fade, the germen becomes an oblong compressed pod, which in warm seasons comes to perfection in England; these ripen late in autumn.

The leaves come out late in the spring, and fall off early in the autumn, which renders this tree less valuable than it would otherwise be.

The False Acacia is best propagated by seeds, which should be sown in a bed of light earth about the latter end of March or the beginning of April; and if the bed has a warm exposure, the plants will appear in six weeks, requiring no other care than keeping them clear from weeds. In this bed the plants should remain till the following spring, when they should be transplanted into the nursery about the end of March, placing them in rows at three feet distance, and a foot and a half asunder in the rows. In this nursery they should remain two years, by which time they will be of size for

transplanting into the places where they are designed to grow. As these trees, when they stand long unremoved, send forth long tough roots, it will be advisable to cut them off when they are transplanted. This operation, however, sometimes occasions their miscarrying.

These trees will grow well almost upon any soil, but they prefer a light sandy ground, in which they have been known to shoot six feet in one year. While the trees are young, they make a fine appearance, being well furnished with leaves; but when old, they are rather unfightly, from the branches being frequently broken by high winds, especially when they happen to stand in an exposed situation. In America this tree is called the Locust Tree. My excellent friend Joseph Harrison, Esq; of Bawtry, has favoured me with the following observations, in a letter dated July 25, 1782. "The
" first experiment that I know of, respecting the application of the timber of the Lo-
" cust Tree, to any purposes in ship-building, was in Virginia, where I resided some
" time about the year 1733: And, there, happening to be acquainted with an inge-
" nious ship-wright, that had been sent over by some merchants of Liverpool, to build
" two large ships, I had frequent conversations with him, respecting the qualities of the
" several principal timber-trees of that country. Being a person of observation, he had
" made many useful remarks on that subject; which the nature of his employment
" afforded many opportunities of doing with advantage. He reckoned the Oaks,
" Elms, Ashes, and many other timber-trees common to both countries, were much
" inferior to the same sorts in England: But frequently spoke of the Locust Tree, as
" of extraordinary qualities both in strength and * duration; and used often to say, if
" a sufficient quantity could be had, it would be the best timber he had ever met with
" for building of ships.—After he had compleated his engagements with his employ-
" ers at Liverpool, he set a small vessel on the stocks for himself; but unluckily, not ha-
" ving a sufficient quantity of iron for the purpose, and none being to be had at that time
" in the country, he was obliged to put a stop to the work, till he bethought himself of
" the following succedaneum. He had formerly (as hinted above) observed the extra-
" ordinary strength and firmness of the Locust Tree, and, on this emergency, took it
" into his head that † Trenails of that timber might be substituted for Iron ‡ Bolts in
" many places where least liable to wrench, or twist, as in fastening the floor timbers
" to the keel, and the knees to the ends of the beams, which two articles take up a
" large proportion of the iron used in a ship, purposing, when he arrived in England,
" to bore out the Locust Trenails, and drive iron bolts in their stead. When he first in-
" formed me of this scheme, I must own I thought the experiment very hazardous:
" However, as necessity has no law, he put it in practice. The ship was built in that
" manner, loaded, and sailed for Liverpool, where she arrived safe; and though they

* DURATION. This property has been well ascertained by some pieces of Locust Tree, still continuing firm and found in some old houses in New-England, that were built when the country was first settled.

† TRENAILS OR TREE-NAILS, are wooden pins, that fasten the planks to the ribs or timbers;—and to prevent drawing, or the planks starting, they are wedged at both ends, inside and out, so that the strength of a ship depends much on the goodness of the Trenails; and if they are not made of wood, that is both hard and tough, they will not endure driving so tight as to bear the strain that lies upon them; for in fact it is the Trenails that hold together the several pieces of which a ship is composed.

‡ BOLTS are round iron pins, used to fasten the floor-timbers to the keel; and the beams that support the decks to the sides of the ship, and on all other occasions where Trenails are not strong enough to bear the strain that is to be supported.

